CRUISE REPORT

C-113

Scientific Activities

Woods Hole - St. John's, NFLD - Lunenburg, NS - Woods Hole

14 July - 24 August 1990

SSV _Corwith Cramer_

Sea Education Association
Woods Hole, Massachusetts

PREFACE

The purpose of this cruise report is to summarize the scientific activities of the cruise C-113 aboard SSV Corwith Cramer. The research effort was directed towards the fulfillment of undergraduate research projects. These projects represent the final fruit of a process which began in Woods Hole during the shore component when possible topics were researched and then refined into written and oral proposals. At sea, a variety of specimens, observations, and measurements were collected and analyzed by the students for presentation to their shipmates. The written projects have been returned to Woods Hole for use in the long-term science objectives of SEA and in helping future students design their work. Much of this work was written at sea and represents a first interpretation of the data.

The hard work of students and staff combined to sail the Cramer north to the ice and back for a very successful voyage. Peg Brandon skillfully guided and led us through fog, ice and rocky shoals with patience and tireless attention. She was helped by three fine mates. Mark Crutcher, the first mate, showed us his top-notch seamanship and educational abilities as well as a remarkable calmness in the face of numerous challenges. John Hayward brought style and ability to watches with great results. Brian Andrews not only met the educational and sailing challenges but worked hard keeping the bosunry going throughout the cruise. Robbie Laird was the wizard of the winch and any other engineering challenge he faced-- thanks for your patience and persistence!

Laura Snyder saw to the galley as our splendid steward, keeping us well fed as well as soothed by her singing. Thank you all very much for your magnificent efforts!

The assistant scientists made the science happen around the clock. Lisa Suatoni did a terrific job keeping our gear going and the lab running smoothly. Amy Abbot had a firm grip on the science and all the various challenges of education and sailing. Eric Schmuck was outstanding in his debut performance as assistant scientist--his humor and geologic input were invaluable. I thank each one for your hard work and patience. It was a real delight to work and sail with you!

We were fortunate on C-113 to have three talented and helpful visitors as shipmates. Kari Lavalli was memorable for sharing her darkroom skills and knowledge. Tim Rumage opened our eyes to the birds and marine mammals with his usual skill and flair. Janie Wulff learned the Cramer's ways and lent a hand during Leg III. Thanks for your knowledge and help!

It was you, the students, that made this a great trip. Your hard work, patience, and willingness saw us all through the six-weeks of challenges around Newfoundland and back! Thanks for it all, you're wonderful shipmates and it was terrific to sail with you.

Chuck (of the North) Lea
Chief Scientist

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INTRODUCTION

This cruise report provides a record of academic and research activities conducted on C-113. Oceanographic research on the cruise was almost entirely devoted to accomplishing individual student projects as part of an academic program. The sea-going program is an extension of courses conducted for six weeks on shore in Woods Hole and emphasizes the application of theoretical concepts to the study of the oceans.

The cruise track of C-110 (Figure 1, Table 1 giving noon and midnight positions) was designed to identify and contrast nearshore, continental shelf, and oceanic environments in the northwestern Atlantic off New England and the Canadian Maritimes. The itinerary of the cruise is given in Table 2 and the cruise participants are listed in Table 3.

The academic program is briefly described and a list of student projects is included. The research summary briefly describes the student research efforts while the appendices give a more detailed listing of the sampling and analytical results.

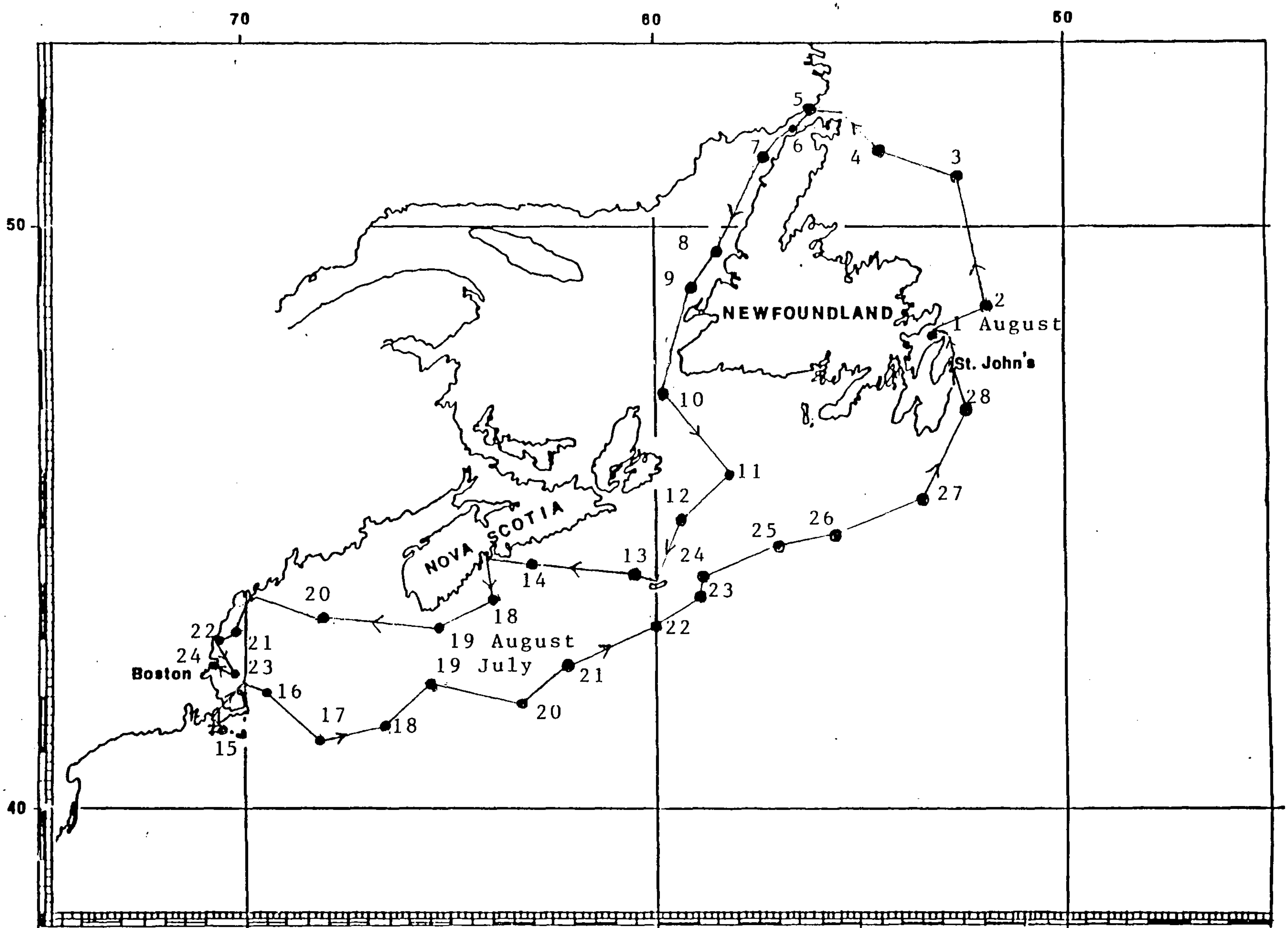


Figure 1. Cruise track of C-113,14 July-24 August 1990. Midnight positions are indicated.

TABLE 1. LIST OF NOON AND MIDNIGHT POSITIONS FOR CRUISE C-113

Date (1990)	Time (hrs)	Log (nm)	Latitude (°N)	Longitude (°W)
07/16	0000	41	42°05′	69°47′
07/17	0000	130	41°24′	68°22′
	1200	179	41°01′	67°28′
07/18	0000	215	41°33′	66°51′
	1200	258	41°57′	65°57′
07/19	0000	293	42°19′	65°05′
	1200	347	42°35′	65°01′
07/20	0000	418	41°55′	63°29′
	1200	467	42°32′	62°48′
07/21	0000	509	42°48′	62°13′
	1200	552	42°44′	61°41′
07/22	0000	598	43°13′	60°00′
	1200	644	43°41′	60°07′
07/23	0000	710	43°53′	59°03′
	1200	742	43°57′	58°56′
07/24	0000	783	44°02′	59°01′
	1200	844	44°13′	57°45′
07/25	0000	897	44°43′	57°06′
	1200	939	45°04′	56°14′
07/26	0000	988	44°51′	55°29′
	1200	1036	45°02′	54°31′
07/27	0000	1088	45°30′	53°33′
	1200	1147	46°16′	52°49′
07/28	0000	1205	47°00′	52°40′
	1200	St. John's, Newfoundland		
07/31	0000	St. John's, Newfoundland		
	1200	1278	48°01′	52°37′
08/01	0000	1331	48°06′	53°22′
	1200	1381	48°27′	52°41′
08/02	0000	1430	48°43′	52°01′
	1200	1536	49°49′	52°15′
08/03	0000	1606	50°49′	52°40′
	1200	1640	51°09′	53°31′

08/04	0000	1692	51°16'	54°33'
	1200	1745	51°44'	55°23'
08/05	0000	1787	51°43'	56°21'
	1200	1787	51°43'	56°21'
08/06	0000	1864	51°30'	56°43'
	1200	1937	51°31'	56°45'
08/07	0000	2016	50°57'	57°30'
	1200	2070	50°25'	58°13'
08/08	0000	2136	49°35'	58°33'
	1200	2177	49°10'	58°11'
08/09	0000	2236	48°56'	58°56'
	1200	2315	47°57'	59°43'
08/10	0000	2356	47°16'	59°47'
	1200	2412	46°30'	59°15'
08/11	0000	2475	45°59'	58°09'
	1200	2520	45°48'	58°24'
08/12	0000	2584	45°13'	59°27'
	1200	2660	44°07'	59°59'
08/13	0000	2698	44°12'	60°29'
	1200	2753	44°22'	61°36'
08/14	0000	2827	44°20'	63°00'
	1200	2896	45°00'	64°03'
08/18	0000	2973	43°41'	64°10'
	1200	3031	43°08'	64°04'
08/19	0000	3098	43°15'	65°19'
	1200	3176	43°10'	66°09'
08/20	0000	3267	43°16'	68°04'
	1200	3361	43°37'	70°08'
08/21	0000	3394	43°15'	70°18'
	1200	Anchored at Shoals Marine Lab		
08/22	0000	Anchored at Shoals Marine Lab		
	1200		42°49'	70°38'
08/23	0000		42°23'	70°19'
	1200		42°27'	70°29'
08/24	0000	Gloucester, Massachusetts		

TABLE 2. ITINERARY OF SSV CORWITH CRAMER CRUISE C-113

Port	Arrive	Depart
Woods Hole, Massachusetts		15 July 1990
St. John's, Newfoundland	28 July	31 July
Red Bay, Labrador	4 August	5 August
Lunenburg, Nova Scotia	14 August	16 August
Portland, Maine*	20 August	20 August
Isles of Shoals, New Hampshire	21 August	22 August
Gloucester, Massachusetts	24 August	

*Customs and Immigration clearance only

TABLE 3. SHIP'S COMPLEMENT ON C-113

NAUTICAL STAFF

Margaret Brandon	Captain
Mark Crutcher	Chief Mate
John Hayward	Second Mate
Brian Andrews	Third Mate
Robert Laird	Engineer
Laura Snyder	Steward

SCIENTIFIC STAFF

Chuck Lea	Chief Scientist
Lisa Suatoni	First Assistant Scientist
Amy Abbot	Second Assistant Scientist
Eric Schmuck	Third Assistant Scientist

VISITORS

Kari Lavalli, Boston University, Marine Program, Leg I
Tim Rumage, Rhode Island School of Design, Leg II
Janie Wulff, Williams College-Mystic Seaport Program in American Maritime Studies, Leg III

STUDENTS

Douglas Armstrong, Cornell University, Sophomore, Computer Science
Michael Barbour, Albion College, Junior, Geology
Diana Barnes, University of Notre Dame, Junior, Physics
Matthew Brady, Westminster College, Junior, Biology
Jane Denny, Colgate University, Sophomore, Geology
Paul Diamond, Colby College, Sophomore, Art History
David Drinkwater-Lunn, Cornell University, Sophomore, Undeclared
Melinda Fagan, Williams College, Sophomore, Undeclared
Brendan Gibbons, Albion College, Sophomore, Biology
Nina Gibson, Rochester Institute of Technology, Sophomore, Imaging Science
Scott Gilbert, University of Pennsylvania, Junior, Biology
Maia Goodall, Mt. Holyoke College, Junior, Psychology
Bette Hecox, Herkimer Community College, Sophomore, Biology
Stephanie Hernstadt, Vassar College, Junior, Biology
Vera Hill, Trinity College, Junior, Area Studies
Ernest Latham, Rice University, Senior, Environmental Science
Rebecca Little, Kenyon College, Freshman, Chemistry
Lauri Livingston, Vanderbilt University, Junior, English
Pamela McGinnis, Emory University, Senior, Biology
Leo Meskis, Wabash College, Junior, Biology
Johanna Skaff, Albion College, Senior, Psychology
Daniel Sullivan, Brown University, Senior, Environmental Science
John Waldren, College of Charleston, Senior, Marine Biology
Amy Wolpert, Simmons College, Sophomore, English
Ashleigh Zimmerman, University of Southern California, Junior, Environmental Engineering

Academic Program

Cruise C-113 represents the second half of the 12-week Sea Semester program. During the first six weeks students took three courses: Oceanography, Nautical Science and Maritime Studies. The projects which the students undertook at sea were researched and proposed during the shore component. The proposal process included both written and oral presentations.

Throughout the cruise, a 24-hour science watch was maintained by a staff member and three students. During this time, students were instructed in the use of sampling and analytical equipment. Science watch standers were responsible for maintenance of the science log, conducting scientific stations, and routine observations and measurements of oceanographic and meteorological conditions. Analyses of water and biological samples were also completed on science watch. The responsibility of the students for these procedures was gradually increased over the duration of the cruise, culminating in each student being designated Junior Science Watch Officer (JSWO) for two or three watches. Responsibility for the efficient running of the lab and the progress of the scientific program rested with these JSWOs.

Formal instruction was given each day in a lecture. The topics covered in these lectures (Table 4) ranged from practical oceanographic sampling to presentations discussing timely or recently observed phenomena as well as theoretical oceanographic or marine biological subjects. Examinations and student presentations were also conducted during these instructional periods.

C-113 was comprised of two three-week courses in Practical

Oceanography offered by SEA with credit transferred through Boston University. Letter grades for the shipboard courses were determined on the basis of on-watch evaluations, exams, and the research project presentation and final written report. These projects are listed in Table 5.

TABLE 4. OCEANOGRAPHY CLASSES GIVEN ABOARD C-113

07/16/90	Bathythermograph and Neuston Net Tow Demonstration	Chuck Lea & Staff
07/17/90	The Georges Bank	Chuck Lea
07/18/90	Silhouette Photography of Plankton	Kari Lavalli
	Langmuir Circulation	Chuck Lea
07/19/90	The Biology of the Tuna	Chuck Lea
07/20/90	Salinometry	Lisa Suatoni
	Fisheries	Chuck Lea
07/23/90	The Winkler Oxygen Titration	Eric Schmuck
	Spectrophotometry and Fluorometry	Amy Abbot
07/24/90	Modern Oceanographic Sampling	Chuck Lea
07/25/90	The Lobsters	Kari Lavalli
07/26/90	The Head of the Sperm Whale	Chuck Lea
07/27/90	Practical Exam	
08/01/90	Geology of Newfoundland and Grand Banks	Erick Schmuck
	Marine Birds	Tim Rumage
08/02/90	Marine Acoustics and Marine Mammals	Tim Rumage
08/03/90	The Whaling Industry at Red Bay, Laborador	Tim Rumage
08/06/90	Invertebrate Zoology I	Lisa Suatoni/Amy Abbot
08/07/90	Invertebrate Zoology II	Lisa Suatoni/Amy Abbot
08/08/90	JSWO, Scientific Papers and Presentations	Chuck Lea
08/09/90	Final Exam	
08/10/90	Student Project Presentations	
08/13/90	Student Project Presentations	
08/17/90	Student Project Presentations	
08/20/90	Student Project Presentations	
08/21/90	Student Project Presentations	

TABLE 5. LIST OF STUDENT PROJECTS

Water Mass Flow into and out of the Gulf of Maine	David Drinkwater
Vertical Mixing and the Distribution of Chlorophyll *a* and Phosphate on Georges Bank	Ashleigh Zimmerman
A Study of the Sediments of Great South Channel, Georges Bank, Northeast Channel, and Browns Bank	Jane Denny
Phosphate and Chlorophyll *a* Levels in the Gulley Submarine Canyon	Maia Goodall
Sediment Distribution in the Gulley Submarine Canyon	Michael Barbour
The Extent of the Labrador Current in July and August 1990	Amy Wolpert
Labrador Current Water in the Laurentian Channel: Temperature-Salinity Characteristics	Douglas Y. Armstrong
Dissolved Oxygen and Phosphate Content in the Waters Surrounding Newfoundland	Dan Sullivan
A Hydrographic Study of the Slope Water Region off Nova Scotia	Diana H. Barnes
A Comparison of Biomass and Diversity of Zooplankton in Shelf and Slope Water off Nova Scotia and on the Edge of a Warm Core Eddy	Stephanie Hernstadt
A Study of the Influence of Thermoclines and Light Intensity on the Depth of the Chlorophyll *a* Maxima in the Gulf of St. Lawrence	P. Leanne McGinnis
Determination of Phytoplankton Biomass by Chlorophyll *a* Concentrations on the Grand Banks of Newfoundland	John T. Waldren
A Hydrographic and Biological Description of Outer Trinity Bay During Summer of 1990	Bette J. Hecox
Phosphate Concentration and Chlorophyll *a* Levels North of Newfoundland during Mid-Summer	Melinda B. Fagan

Vertical Distribution of Oxygen in the Bay of Islands Fjords	Vera Hill
Phosphate and Silicate Distributions in the Bay of Islands Fjords	Rebecca E. Little
A Study of Factors Influencing Primary Production in the Northwest Atlantic Ocean	Scott J. Gilbert
Zooplankton Diversity as a Function of Depth in the Northwestern Atlantic Ocean	Matthew Brady
Pteropods as Indicators of Water Types off Nova Scotia and Newfoundland	Leo Meskis
Gelatinous Zooplankton Occurrence, Feeding Habits, and Water Masses	Brendan Gibbons
Otter Trawl Collections from Continental Shelf Areas off Nova Scotia	Lauri Livingston
Sea Bird Distribution in Relation to Oceanic Processes	Johanna Skaff
A Study of Surface Pelagic Micro Tar in the Waters Surrounding Newfoundland	Paul Diamond
Horizontal Surface Distribution of Pelagic Macrotar and Macroplastics in the Northwest Atlantic	Chris Latham
Experimental Analysis of Physical Factors Affecting Sea Surface Temperature (SST) Measurement Methods using a Canvas Bucket	Nina Gibson

Research Summary

The research plan of cruise C-113 was designed not only to fulfill student projects at specific sites, such as Georges Banks or Bay of Islands, but also to allow study of larger scale phenomena such as the distribution of zooplankton and water masses.

The first area of interest examined on the cruise was Georges Bank, which is bounded by Northeast Channel, the Gulf of Maine, Great South Channel and the open Atlantic. Slope Water and water of Labrador Current origin flow into the Gulf of Maine through the Northeast Channel. This water exits the Gulf of Maine through Great South Channel as Maine Surface, Intermediate and Bottom Water. Traces of Maine Bottom Water were also found near the bottom of Northeast Channel (David Drinkwater). The extensive vertical mixing on Georges Bank, caused by the strong tidal currents, appeared to be responsible for relatively high phosphate and chlorophyll a concentrations in areas shallower than 60m when compared to deeper adjacent areas (Ashleigh Zimmerman). The currents also helped shape sediment distribution. Generally finer sediment was found in Great South Channel while, on the bank tops of Georges and Browns Bank and in Northeast Channel, coarser sediment remained as evidence of the strong tidal current action (Jane Denny).

Site specific work was conducted at the Gulley, a large submarine canyon northeast of Sable Island Bank. Comparisons of chlorophyll a and phosphate profiles showed little consistency along the canyon axis or in comparison with the neighboring continental shelves, suggesting an active mixing of upper water column and a current regime near the canyon (Maia Goodall). The sediment distribution within the canyon indicated deposition and transport along the southwestern margin of the canyon and erosion on the northeastern side, suggesting greater current velocities on the northeastern side (Michael Barbour).

The Labrador Current extends from north of Newfoundland to the deep ocean south of Nova Scotia. On C-113, little trace of unmixed Labrador Current water was found west of 60°W south of Nova Scotia, although it occupied as much as 130m of the water column at the mouth of the Laurentian Channel (Amy Wolpert). Temperature and salinity analyses of Laurentian Channel water suggest that a portion of the inshore Labrador Current flows into the channel but loses its distinctive characteristics by mixing with Gulf of St. Lawrence water before the Cabot Strait (Doug Armstrong). Dissolved oxygen concentrations were also used to examine the flow of Labrador current waters. Generally higher values were found north of Newfoundland than on the Grand Banks or to the south, and differences in the oxygen profiles south of the Strait of Belle Isle suggest that little Labrador Current water is flowing into the Gulf of St. Lawrence from the north (Dan Sullivan).

Slope Water is formed in a region off the continental slope from New England to the Grand Banks. Temperature and salinity comparisons indicate that North Atlantic Central Water, Gulf Stream water, the Labrador Current and Coastal water combine to form either warm or cold Slope Water in the region south of Nova Scotia (Diana Barnes). Biological work in this area and on the adjacent shelf also indicates great complexity. High zooplankton biomass with low taxonomic diversity was characteristic of the shelf waters, while slope waters had a relatively low zooplankton biomass with more taxonomic diversity. The presence of a nearby warm core eddy was thought to influence the assemblage of the zooplankton taxa (Stephanie Hernstadt).

Chlorophyll a and phosphate concentrations were determined at four stations from the continental slope to the Avalon Channel, including on top of the Grand Banks. No shelf/slope front was identified, and the chlorophyll a maximum was determined to be at a depth of about 40m in all areas, the approximate depth of the 1% light level (John Waldren).

The waters of Trinity Bay on the northern side of Newfoundland were sampled about half way into the Bay. The Bay appears to be well flushed by Labrador Current water; however, the western side of the Bay showed less chlorophyll a in the upper water column than the eastern side, suggesting differing circulatory processes on either side (Bette Hecox). Chlorophyll a profiles near Newfoundland were the object of two studies. To the northwest of Trinity Bay, the offshore waters of Newfoundland were analyzed for phosphate and chlorophyll a concentrations. Chlorophyll a maxima were generally found at the surface and near the seasonal thermocline, with phosphate minima at the same depths (Melinda Fagan). In the Gulf of St. Lawrence along the western side of Newfoundland, the chlorophyll a maximum also occurred within the seasonal thermocline; however, at a station outside the Bay of Islands, no strong thermocline had developed and the chlorophyll a concentrations were relatively high throughout the 50m water column (Leanne McGinnis).

The Bay of Islands on Newfoundland's west coast is a large fjord with several arms branching from it. One fjord, Middle Arm, branches into two smaller ones--Goose and Penguin Arm. On C-113, sampling took place in the Bay, Middle Arm and Goose Arm. The presence of a shallow geologic sill at the entrance to Middle Arm appears to restrict the flow of water into and out of this fjord at the lower levels. Oxygen concentrations were found to be lower in the deep basin of Middle Arm than at comparable levels in the open Bay (Vera Hill). Restricted vertical circulation influences the phosphate and silicate profiles with dramatic rises in the concentration of both below the thermocline. Some dissolved silica appeared to be entering the system from a fresh water stream in Middle Arm (Rebecca Little).

A variety of work was done over broad regions in several biologically related fields. Primary production and chlorophyll _a_ measurements were made along the cruise track and the results suggest that the amount of chlorophyll _a_ was not a good indicator of the rate of photosynthesis (Scott Gilbert). Zooplankton collected by meter net tows generally supported a trend of increasing biomass and decreasing taxonomic diversity with decreasing water depth (Matt Brady). Among the zooplankton, the pteropod molluscs were found to be useful as indicator species. _Limacina retroversa_ was prevalent in the warmer shelf and oceanic water, while _L. helicina_ was more common in the cooler, more saline water off Newfoundland and the Gulf of St. Lawrence (Leo Meskis).

The distribution of gelatinous zooplankton indicated the presence of more scyphozoans in waters with relatively high zooplankton biomass, while salps occurred in collections which were relatively low in biomass (Brendan Gibbons). Otter trawl collections brought a rich assemblage of benthic life. A trawl on Sable Island Bank indicated fish stomach contents heavily dominated by sand lance (Lauri Livingston). The sea birds present in the study area suggested that changing water masses can influence bird species and numbers. This was particularly noticeable at the Strait of Belle Isle (Johanna Skaff).

Pelagic pollution was present in the form of tar and plastic. Microscopically visible tar was collected from surface waters along the entire track, particularly at the mouth of the Laurentian Channel. Also visible microscopically were small "fibers" thought to be of plastic (Paul Diamond). Macroscopic floating tar and plastic collected in neuston net tows showed the highest concentrations at the mouth of the Laurentian Channel (Chris Latham).

In an attempt to model 19th century sea surface temperature measuring equipment, a canvas bucket was constructed. The changes in temperature over several minutes of a water sample collected in the bucket was recorded in an attempt to give a better basis for corrections now applied to the historical sea surface temperature record (Nina Gibson). Improved correction of the historical record could be important in estimates of global temperature change.

The wide variety of research goals on C-113 defies brief summary; however, it is safe to say that the scientific activity provided a firm base for the educational objectives of all aboard the Cramer.

Appendix A. STATION INFORMATION SUMMARY OF C-113. (THE NUMBER OF NISKIN BOTTLES USED IN THE HYDROCAST IS IN PARENTHESES.)

Station C-113-	Date 1990	Log (nm)	Latitude (° N)	Longitude (° W)	Equipment/Activity
1	7/16	47.3	47°04′	69°45′	Shipek, CTD
2	7/10	63.7	41°56′	69°27′	Shipek, CTD
3	7/16	79.6	41°48′	69°06′	Shipek, CTD
4	7/16	97.3	41°39′	68°43′	Shipek, CTD
5	7/16	101.9	41°43′	68°49′	Neuston net
6	7/17	130.2	41°23′	68°28′	Shipek, CTD, Hydrocast (6)
7	7/17	142.1	41°15′	68°12′	Shipek, CTD, Hydrocast (4)
8	7/17	183.1	41°10′	67°28′	Shipek, CTD, Hydrocast (4), Phyto. net
9	7/17	191.4	41°16′	66°23′	Ottertrawl
10	7/17	205.5	41°30′	67°01′	Meter net
11	7/18	218.7	41°33′	66°51′	Neuston net
12	7/18	256.7	41°56′	66°02′	Shipek, CTD, Hydrocast (5), Phyto. net
13	7/18	277.9	42°05′	65°59′	Shipek, CTD
14	7/18	279.5	42°08′	65°55′	Shipek, CTD
15	7/18	288.6	42°15′	65°51′	Shipek, CTD
16	7/19	293.0	42°19′	65°46′	Shipek, CTD, Meter net
17	7/19	328.1	42°37′	65°18′	Shipek
18	7/19	417.8	41°55′	63°36′	CTD, Hydrocast (7), Phyto. net
19	7/20	460.5	42°25′	62°52′	CTD
20	7/20	468.2	42°32′	62°48′	Neuston net
21	7/20	489.7	42°57′	62°40′	CTD, Hydrocast (5), Phyto. net, Meter net
22	7/21	512.8	42°47′	62°09′	CTD, Hydrocast (4)
23	7/21	536.9	42°28′	61°49′	CTD, Hydrocast (7), Phyto. net
24	7/21	591.4	43°08′	61°02′	Meter net
25	7/22	638.6	43°39′	60°09′	Shipek, CTD, Hydrocast (6), Phyto. net
26	7/22	701.4	43°47′	58°55′	CTD, Hydrocast (11), Meter net
27	7/23	716.0	43°59′	59°07′	Meter net, Phyto. net
28	7/23	723.0	43°57′	58°59′	Meter net
29	7/23	730.1	43°56′	59°04′	Shipek, CTD, Hydrocast (6)
30	7/23	730.4	43°55′	59°03′	Shipek
31	7/23	732.8	43°55′	59°02′	Shipek
32	7/23	735.0	43°55′	58°59′	CTD, Hydrocast (6)
33	7/23	738.9	43°55′	58°56′	Shipek
34	7/23	741.3	43°55′	58°55′	Shipek
35	7/23	744.7	43°59′	58°54′	Shipek
36	7/23	770.3	43°52′	58°55′	CTD
37	7/23	783.4	40°02′	59°82′	CTD, Hydrocast (6)
38	7/24	844.1	44°13′	57°45′	Neuston net
39	7/24	891.7	44°89′	57°14′	CTD
40	7/25	906.5	44°47′	56°53′	CTD
41	7/25	926.8	44°59′	56°29′	CTD
42	7/26	939.6	45°04′	56°12′	Neuston net
43	7/26	946.9	44°59′	56°12′	CTD
44	7/26	987.4	44°51′	55°28′	Midwater trawl
45	7/26	1029.0	45°03′	54°24′	CTD, Hydrocast (6), Secchi

46	7/26	1064.5	45°13′	53°54′	CTD, Hydrocast (6), Secchi
47	7/27	1126.8	45°59′	52°60′	CTD, Hydrocast (6)
48	7/27	1147.0	46°15′	52°48′	CTD, Hydrocast (6), Secchi, Phyto. net
49	7/31	1278.3	48°01′	52°37′	Neuston net
50	7/31	1333.2	48°04′	53°14′	CTD, Hydrocast (5)
51	8/01	1343.3	48°04′	53°19′	CTD, Hydrocast (2), Meter net
52	8/01	1346.5	48°07′	53°25′	CTD, Hydrocast (5)
53	8/03	1630.1	51°05′	53°16′	CTD, Hydrocast (7)
54	8/03	1675.7	51°11′	54°12′	Neuston net
55	8/03	1676.5	51°10′	54°19′	CTD, Hydrocast (6)
56	8/04	1728.8	51°34′	54°59′	CTD, Hydrocast (6), Phyto. net
57	8/07	2015.5	50°57′	57°30′	Neuston net
58	8/07	2051.9	50°43′	58°08′	CTD, Hydrocast (6), Phyto. net
59	8/07	2076.9	50°21′	58°21′	CTD, Hydrocast (6), Phyto. net
60	8/07	2129.8	49°38′	58°30′	Meter net
61	8/08	2159.4	49°14′	58°35′	CTD, Hydrocast (5), Phyto. net
62	8/08	2174.3	49°10′	58°14′	CTD, Hydrocast (6), Phyto. net
63	8/08	2182.5	49°09′	58°02′	CTD, Hydrocast (6), Phyto. net
64	8/08	2185.8	49°03′	57°57′	CTD, Hydrocast (4), Phyto. net
65	8/08	2187.1	49°09′	57°55′	CTD, Hydrocast (3), Phyto. net
66	8/08	2328.0	47°46′	59°41′	CTD
67	8/09	2328.0	47°08′	59°43′	CTD
68	8/09	2349.1	47°28′	59°43′	Neuston net
69	8/09	2358.3	47°16′	59°46′	CTD
70	8/10	2360.3	47°13′	59°50′	Neuston net
71-a	8/10	2369.5	47°05′	59°53′	CTD
71-b	8/11	2549.9	45°26′	58°46′	Otter trawl
72	8/10	2460.3	46°05′	58°25′	Neuston net
73	8/18	3060.5	43°06′	64°30′	Neuston net

Appendix B. BATHYTHERMOGRAPH STATION INFORMATION

BT #	DATE 1990	TIME	LOG (nm)	LATITUDE (° N)	LONGITUDE (° W)	LOCALE	SURF. TEMP (°C)	TEMP AT 50m (°C)	TEMP AT 100m (°C)
1	7/16	1220	88.7	41°42′	68°53′	Great South Channel	17.8	5.5	4.6
2	7/16	1530	99.5	41°43′	68°43′	Great South Channel	17.2	6.0	
3	7/16	2020	118.5	41°36′	68°31′	Great South Channel	17.0	5.0	4.0
4	7/16	1120	173.7	41°00′	67°29′	Georges Bank	12.8	11.0	
5	7/18	0400	231.0	41°41′	66°37′	Georges Bank	13.3		
6	7/18	0835	251.7	41°54′	66°14′	Georges Bank	15.3	7.7	
7	7/19	1130	345.2	42°38′	65°02′	Off Brown's Bank	14.7	4.0	
8	7/19	1340	361.5	42°24′	64°42′	Scotian Shelf Break	15.9	4.5	
9	7/19	1555	379.5	42°15′	64°25′	Scotian Shelf Break	16.6	7.0	
10	7/19	1750	394.5	42°06′	64°06′	Scotian Shelf Break	18.4	15.9	
11	7/19	2025	416.0	42°52′	63°37′	Slope Off Brown's Bank	16.2		
12	7/20	0635	441.5	42°13′	63°12′	Scotian Slope	16.2		
13	7/21	1446	563.8	42°53′	61°33′	Scotian Slope	14.9	8.3	11.5
14	7/21	2115	590.8	43°07′	61°03′	Scotian Slope	13.9	1.0	8.5
15	7/22	0220	604.6	43°18′	60°48′	Scotian Shelf	12.9	1.0	1.2
16	7/22	0635	621.1	43°31′	60°30′	Scotian Shelf	12.2		
17	7/22	1440	664.5	43°39′	59°41′	S. of Sable Island	14.7	4.0	
18	7/22	1808	692.8	43°43′	59°05′	Sable Island Bank	14.6	2.5	
19	7/24	0445	801.4	44°07′	58°39′	N.W. of Gulley	14.6	4.5	
20	7/24	0740	816.5	44°11′	58°21′	N.W. of Gulley	15.3	0.0	0.5
21	7/24	0945	830.3	44°16′	58°03′	Scotian Slope	13.9	0.3	4.0
22	7/24	1702	866.2	44°21′	57°23′	Scotian Slope	14.4	3.4	1.8
23	7/24	0240	994.2	44°53′	55°25′	Slope Grand Banks	14.2	2.5	4.5
24	7/26	1110	1030.9	45°01′	54°37′	Grand Banks Shelf	15.7	6.0	10.6
25	7/26	1745	1057.8	45°10′	54°02′	Grand Banks Shelf	14.0	0.5	
26	7/26	2316	1083.0	45°27′	53°37′	Grand Banks Shelf	13.2	0.0	
27	7/27	0220	1104.4	45°42′	53°20′	Grand Banks Shelf	12.3	0.0	
28	7/31	2025	1325.1	48°06′	53°10′	Trinity Bay	11.7	-0.5	-1.0
29	8/01	0810	1360.8	48°16′	53°09′	Trinity Bay	12.0	0.0	-0.9
30	8/01	1158	1378.2	48°16′	53°09′	Trinity Bay	11.4	-0.7	
31	8/01	1325	1393.8	44°34′	52°30′	Funk Island Bank	11.3	-1.0	-1.3
32	8/01	1640	1421.4	48°48′	52°04′	Funk Island Bank	9.5	-1.1	-0.8
33	8/01	2138	1445.6	48°47′	51°43′	Funk Island Bank	10.1	0.3	0.0
34	8/02	0140	1469.4	48°48′	52°13′	Funk Island Bank	11.1	-0.1	-0.1
35	8/02	0620	1494.0	49°09′	52°29′	Funk Island Bank	10.9	-0.5	-0.8
36	8/02	0920	1516.5	49°32′	52°20′	Funk Island Bank	9.4	-1.1	
37	8/02	1205	1535.2	49°32′	52°21′	Funk Island Bank	9.6	-0.5	-0.5
38	8/02	1650	1567.8	50°23′	52°03′	Funk Island Bank	8.4	0.0	-0.7
39	8/02	2120	1592.6	50°41′	52°24′	Funk Island Bank	9.0	0.0	
40	8/03	0420	1620.0	50°58′	53°00′	Funk Island Bank	7.4	-1.0	-0.7
41	8/03	1345	1650.1	51°10′	53°43′	75m E. of Belle Isle	8.1	-0.8	
42	8/03	1725	1672.9	51°10′	54°11′	Near Iceberg E. of Belle Isle	7.8	-1.1	
43	8/04	0220	1706.0	51°28′	54°35′	SE of Belle Isle	8.9	-1.0	-1.3
44	8/04	1520	1767.1	51°45′	55°52′	Belle Isle	8.8		
45	8/04	1720	1782.9	51°43′	56°14′	Belle Isle	9.4	0.3	
46	8/05	1450	1806.8	51°35′	56°14′	Belle Isle	10.6	-0.5	
47	8/06	0411	1888.7	51°25′	56°37′	Strait of Belle Isle	14.9	3.5	

BT #	DATE 1990	TIME	LOG (nm)	LATITUDE (° N)	LONGITUDE (° W)	LOCALE	SURF. TEMP (°C)	TEMP AT 50m (°C)	TEMP AT 100m (°C)
48	8/06	1035	1926.0	51°25′	56°37′	Strait of Belle Isle	15.4	7.0	
49	8/06	1203	1937.0	51°30′	56°44′	Strait of Belle Isle	14.1	2.4	
50	8/06	1530	1953.3	51°33′	56°41′	Strait of Belle Isle	10.4		
51	8/06	2230	2005.3	51°02′	57°20′	Strait of Belle Isle	10.4	-0.5	
52	8/07	0315	2030.9	50°54′	57°36′	Gulf of St. Laurence	15.2	-1.0	
53	8/07	0715	2051.3	50°43′	58°08′	Gulf of St. Laurence	9.9	-0.8	
54	8/07	1208	2071.6	50°24′	58°14′	Gulf of St. Laurence	14.2	-1.3	
55	8/07	2140	2027.1	49°39′	58°28′	Gulf of St. Laurence	14.7		
56	8/08	0355	2158.9	49°15′	58°37′	Gulf of St. Laurence	14.7	0.0	
57	8/08	1050	2171.7	49°08′	58°18′	Bay of Islands	15.9		
58	8/11	0244	2488.9	45°53′	57°54′	E. of Cape Breton	14.4	0.5	-0.3
59	8/11	0742	2508.7	45°52′	58°17′	E. of Cape Breton	15.3	4.5	0.3
60	8/11	1315	2529.1	45°41′	58°36′	E. of Cape Breton	16.7	1.5	
61	8/11	1417	2537.4	45°35′	58°36′	E. of Cape Breton	17.2	2.0	2.0
62	8/11	2028	2567.0	45°17′	59°06′	E. of Cape Breton	16.3	11.8	
63	8/12	0140	2587.8	45°10′	59°30′	E. of Cape Breton	16.8	1.5	
64	8/12	0453	2611.7	44°50′	59°38′	E. of Cape Breton	16.3	1.7	1.0
65	8/12	0800	2632.4	44°32′	59°47′	N. of Sable Island	17.5	3.0	
66	8/12	1112	2654.8	44°12′	59°57′	N. of Sable Island	17.8		
67	8/12	2110	2682.4	44°06′	60°10′	N. of Sable Island	17.8	2.7	
68	8/13	0030	2700.7	44°12′	60°33′	N. of Sable Island	17.3	2.3	
69	8/13	0550	2720.2	44°17′	60°58′	N. of Sable Island	19.7	4.7	
70	8/13	1035	2741.6	44°22′	61°21′	Sable Bank	19.7	2.4	6.3
71	8/13	1310	2761.4	44°21′	61°47′	Sable Bank	20.7	3.5	7.3
72	8/13	1650	2781.6	44°31′	62°06′	Sable Bank	20.8	3.5	6.5
73	8/13	2013	2802.1	44°32′	62°34′	Sable Bank	20.0	3.0	
74	8/13	2318	2822.9	44°23′	62°58′	Sable Bank	19.7	0.0	2.5
75	8/14	0210	2842.2	44°17′	63°27′	Sable Bank	19.3	4.9	
76	8/14	0557	2869.9	44°18′	63°58′	Sable Bank	19.6	4.2	
77	8/17	1741	2940.3	43°37′	63°38′	Off Lunenberg	20.8	3.7	7.5
78	8/18	0113	2980.3	43°43′	64°19′	LaHave Bank	19.8	2.4	
79	8/18	0925	3020.0	43°20′	64°14′	LaHave Bank	20.8	1.7	
80	8/18	1325	3037.3	43°02′	64°02′	LaHave Bank	21.2	3.3	
81	8/18	1905	3065.2	43°08′	64°38′	LaHave Bank	21.2	2.0	
82	8/18	2315	3095.9	43°15′	65°14′	LaHave Bank	18.3	3.0	3.7
83	8/19	1151	3175.8	43°10′	66°08′	So. of Nova Scotia	10.2	8.0	
84	8/19	1510	3202.7	43°06′	66°41′	So. of Nova Scotia	13.3	10.0	
85	8/19	1725	3222.2	43°07′	67°02′	So. of Nova Scotia	17.7	11.0	
86	8/19	2006	3242.5	43°12′	67°34′	So. of Nova Scotia	18.4	11.0	10.2
87	8/19	2330	3264.1	43°17′	68°02′	So. of Nova Scotia	17.5	10.4	
88	8/20	0310	3289.4	43°20′	68°35′	East of Portland	16.2	10.0	
89	8/20	0445	3311.1	43°20′	69°04′	East of Portland	13.3	8.3	
90	8/20	0725	3332.4	43°26′	69°34′	East of Portland	15.4	8.5	

Appendix C. C-113 HYDROCAST INFORMATION SUMMARY

Station No. C113-	Bottle	Depth (m)	Phosphate (µM/L)	Oxygen (ml/1)	Chlorophyll (µg/1)	Salinity (‰)	Silicate (µM/L)
6	1	40	0.61		0.26		
	2	30	0.62		0.09	33.356	
	3	25			0.24	35.907	
	4	15	0.97		0.57	36.097	
	5	10	0.04		0.30	35.734	
	6	0	0.00		0.13	33.333	
7	1	25	0.10		2.23		
	2	15	0.46		1.23		
	3	10	0.40		1.92		
	4	0	0.44		0.86		
8	1	25	0.40		0.75		
	2	15	0.57		0.76		
	3	10	0.36		1.10		
	4	0	0.36		0.89		
12	1	35	0.90		0.13		
	2	25	1.16		0.12		
	3	15	0.17		1.42		
	4	10	0.20		0.11		
	5	0	0.31		0.16		1.38
18	1	150	0.83	1.350	0.01	35.890	
	2	125	0.60	1.380		35.752	
	3	100	0.57	1.630	0.01		
	4	75	0.43	1.600	0.15		
	5	50	0.25	1.650	0.48		
	6	25	0.05	3.428	0.02		
	7	0	0.06	1.840			
21	1	40	1.07		0.41		
	2	30	0.48		1.13		
	3	20	0.47		0.34		
	4	10	0.50		0.16		
	5	0	0.37	0.384	0.08		
23	1	800	1.32	7.185		34.956	
	2	600	1.47	6.086		34.948	
	3	500	1.32	3.009		34.969	
	4	400	1.76	5.321		31.989	
	5	250	1.16	5.284			
	6	100	1.16	6.326			
	7	0	0.14		0.10	32.211	1.17

Station No. C113-	Bottle	Depth (m)	Phosphate (μM/L)	Oxygen (ml/1)	Chlorophyll (μg/1)	Salinity (‰)	Silicate (μM/L)
25	1	35	0.25				
	2	25	0.40				
	3	20	0.47				
	4	15	0.34				
	5	10	0.13				
	6	0	0.57				0.76
26	1	800	1.18	7.620	0.01		
	2	600	1.21	-	0.01		
	3	500	1.24	4.979	0.01		
	4	400	1.27	5.156	0.00		
	5	250	1.58	4.910	0.01		
	6	150	1.20	4.970	0.01		
	7	100	0.93	5.750	0.00		
	8	75	0.87	6.600	0.01		
	9	50	0.53	7.370	0.00		
	10	25	0.02	6.150	0.01		
	11	0	0.08	6.580			
29	1	75	1.07		0.05		
	2	50	1.07		0.15		
	3	35	0.64		0.23		
	4	20	0.52		0.14		
	5	10	0.42		1.32		
	6	0	0.51		0.62		
32	1	75	1.27		0.01		
	2	50	1.05				
	3	35	0.81		0.12		
	4	20	0.59		0.33		
	5	10	0.38		0.02		
	6	0	0.60		0.19		
37	1	75	1.35		0.02		
	2	50	0.86				
	3	35	0.46		0.11		
	4	20	0.98		0.19		
	5	10	0.80		0.45		
	6	0	0.31				
45	1	115	0.91	5.540	0.03		
	2	75	1.26		0.04		
	3	40	0.18	7.328	0.22		
	4	30	0.22	6.773	0.16		
	5	10	0.33	6.244	0.12		
	6	0	0.37	6.158	0.17		

Station No. C113-	Bottle	Depth (m)	Phosphate (μM/L)	Oxygen (ml/1)	Chlorophyll (μg/1)	Salinity (‰)	Silicate (μM/L)
46	1	60	1.16	1.950	0.10		
	2	45	0.23	3.060	0.27		
	3	30	0.19	2.580	0.03		
	4	20	0.14	3.330	0.01		
	5	10	0.22	2.664	0.45		
	6	0	0.11	2.414	0.08		
47	1	60	0.56	4.530	1.94		
	2	45	0.64	2.657	0.27		
	3	30	0.37	3.269	0.27		
	4	20	0.22	3.069	0.11		
	5	10	0.45	2.558	0.30		
	6	0	0.42	3.351	0.07		
48	1	120	1.01	2.487	0.05		
	2	75	0.22	3.091	0.27		
	3	40	0.75	3.026	0.21		
	4	30	0.16	3.408	2.97		
	5	10	0.14	2.252	0.08		
	6	0	0.13	2.443		0.341	
50	1	75					
	2	50		3.371			
	3	25		2.514			
	4	15		2.849			
	5	0		3.366			
51	1	470		2.250			
	2	320		2.920			
52	1	75		4.820			
	2	50		7.240			
	3	25		4.680			
	4	15		4.380			
	5	0		5.320			
53	1	370	1.28	7.230	0.07		
	2	275	1.05	7.480	0.11		
	3	125	0.93	8.140	0.12		
	4	50	0.95	8.490	0.12		
	5	25	0.39	9.770	0.14		
	6	15	0.27	8.030	0.10		
	7	0	0.49	7.880	0.16		0.43
55	1	235	1.04	5.760	0.01		
	2	125	0.99		0.05		
	3	50	0.87	5.915	0.24		
	4	25	0.29	4.242	0.28		
	5	15	0.34	3.874	0.14		
	6	0	0.74	3.289	0.18		

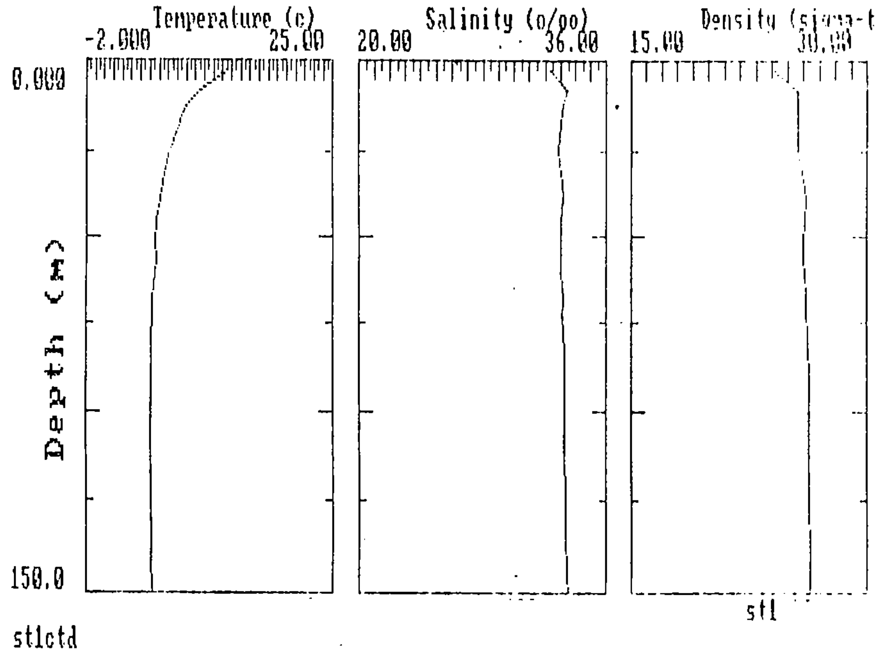
Station No. C113-	Bottle	Depth (m)	Phosphate (μM/L)	Oxygen (ml/1)	Chlorophyll (μg/1)	Salinity (‰)	Silicate (μM/L)
56	1	150	1.13	7.280	0.03		
	2	135	1.25	6.080	0.06		
	3	125	1.09	8.670	0.30		
	4	100	0.71	7.920	0.38		
	5	25	0.40	7.610	0.42		
	6	0	0.46	7.050	0.54		1.91
58	1	80		8.055	0.07		3.35
	2	50		8.163	0.03		4.43
	3	25		8.804	0.20		1.80
	4	15		8.394	0.10		0.78
	5	10		8.084	0.18		0.38
	6	0		7.541	0.10		0.65
59	1	270	2.43		0.01		
	2	150	1.68	2.850	0.01		
	3	75	1.20	6.390	0.01		
	4	50	1.00	6.090	0.16		
	5	25	0.61	7.895	0.25		
	6	0	0.30	6.904	0.13		
61	1	50	0.30	3.425	0.30		
	2	35	0.20	3.671	0.20		
	3	25	0.27	4.290	0.27		
	4	10	0.26	3.030	0.26		
	5	0	0.23	3.420	0.23		
62	1	196	1.36	6.160			4.01
	2	166	1.34	6.080			1.74
	3	125	1.30	6.230			3.04
	4	50	0.92	6.580			0.41
	5	25	0.53	3.950			0.13
	6	0	0.22	5.010			0.45
63	1	195	1.28	4.920			6.24
	2	165	1.24	4.720			3.06
	3	125	1.22	4.550			3.62
	4	50	0.82	5.890			1.73
	5	25	0.38	4.950			0.33
	6	0	0.21	4.720	0.23		1.71
64	1	75	1.29	4.309			2.39
	2	50	0.76	4.508			0.93
	3	25	0.53	4.337			0.30
	4	0	0.24	4.053	0.30		0.78
65	1	20	0.17	3.868			0.86
	2	10	0.34	4.060			0.63
	3	0	0.62		0.34		2.28

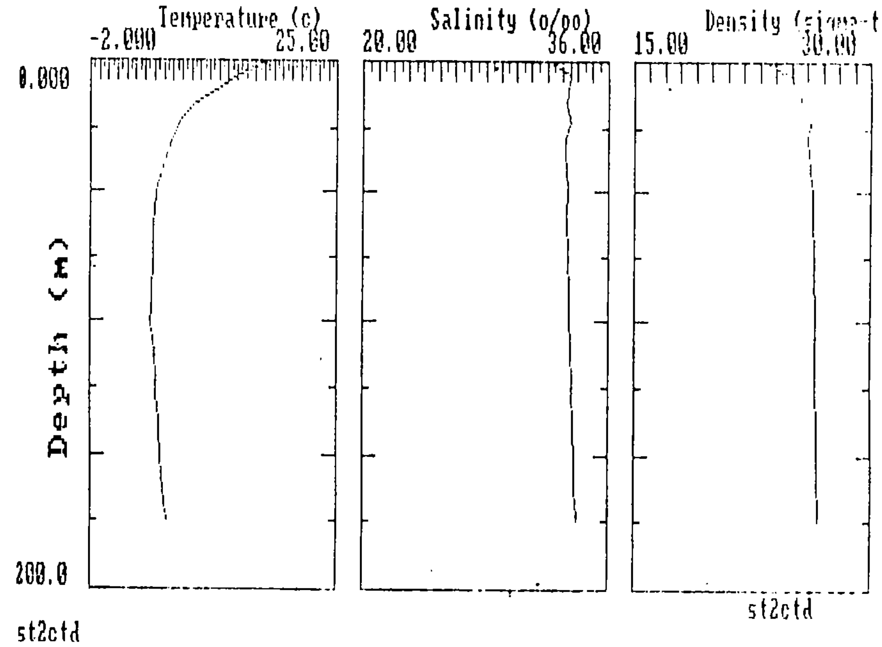
Appendix D. CTD STATION INFORMATION

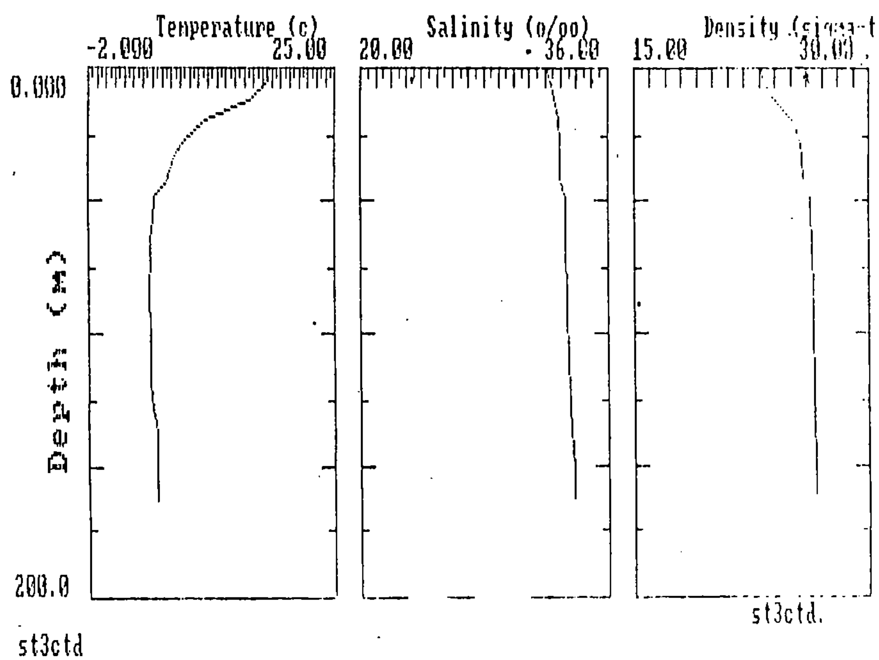
Station C-113-	Date 1990	Log (nm)	Latitude (° N)	Longitude (° W)	Cast Depth (m)	Locale
1	7/16	47.3	42°03′	69°45′	150	Great South Channel
2	7/16	63.7	41°56′	69°27′	200	Great South/Georges Bank
3	7/16	79.6	41°48′	69°60′	179	Great South Channel
4	7/16	97.3	41°39′	68°43′	165	Great South Channel
6	7/16	130.2	41°23′	68°23′	55	Georges Bank
7	7/17	142.1	41°15′	68°11′	36	Georges Bank
8	7/17	183.1	41°10′	67°27′	30	Georges Bank
12	7/18	256.6	41°55′	66°02′	90	Georges Bank
13	7/18	277.9	42°04′	65°58′	180	Northeast Channel
14	7/18	279.5	42°08′	65°59′	218	Northeast Channel
15	7/18	288.6	42°15′	65°50′	215	Northeast Channel
16	7/19	293.0	42°19′	65°45′	150	Northeast Channel
18-a	7/19	417.7	41°53′	63°36′	1200	Slope
18-b	7/19	417.7	41°55′	63°30′	150	Slope
19	7/20	460.5	42°25′	62°52′	1050	Scotian Shelf
21-a	7/20	489.7	42°57′	62°40′	100	Scotian Shelf
21-b	7/20	489.7	42°58′	62°39′	40	Scotian Shelf
22	7/21	512.8	42°47′	62°09′	1000	Scotian Shelf
23	7/21	536.9	42°28′	61°47′	1000	Scotian Shelf/Slope
25-a	7/22	638.6	43°39′	60°09′	64	Sable Island Bank
25-b	7/22	638.6	43°39′	60°09′	64	Sable Island Bank
26	7/22	701.4	43°47′	58°55′	1000	Sable Island Bank
29	7/23	730.1	43°56′	59°04′	80	Scotian Shelf/S.W. Gulley
32	7/23	735.0	43°55′	59°00′	950	The Gulley
36	7/23	770.0	43°52′	59°00′	950	The Gulley
37	7/23	783.4	40°01′	59°82′	1000	The Gulley
39	7/24	891.7	44°40′	57°14′	285	Laurentian Channel
40	7/25	906.5	44°47′	56°53′	405	Laurentian Channel
41	7/25	926.8	44°59′	56°30′	405	Laurentian Channel
43	7/25	946.9	45°03′	56°12′	240	Laurentian Channel
45-a	7/26	1041.4	45°03′	54°24′	145	Grand Banks
45-b	7/26	1041.4	45°03′	54°24′	80	Grand Banks
46	7/26	1063.5	45°13′	53°54′	75	Grand Banks
47	7/27	1126.8	45°59′	53°00′	85	Grand Banks (Avalon Channel)
48	7/27	1147.0	46°16′	52°48′	140	Grand Banks (Northern)
50-a	7/31	1333.2	48°04′	53°14′	175	Trinity Bay
50-b	7/31	1333.2	48°04′	53°14′	80	Trinity Bay
51	8/01	1343.2	48°04′	53°19′	150	Trinity Bay
52	8/01	1346.5	48°07′	53°25′	165	Trinity Bay
53	8/03	1630.1	51°05′	53°16′	380	Funk Island Bank
55	8/03	1683.8	51°09′	54°31′	245	North of Newfoundland
56	8/04	1728.8	51°10′	54°58′	160	East of Belle Isle
58	8/07	2051.9	50°42′	58°08′	85	Gulf of St. Lawrence
59	8/07	2076.9	50°21′	58°21′	306	North Gulf of St. Lawrence
61-a	8/08	2159.4	49°14′	58°35′	60	Outside Bay of Islands
61-b	8/08	2159.4	49°14′	58°35′	55	Outside Bay of Islands
62-a	8/08	2174.3	49°10′	58°14′	200	Bay of Islands

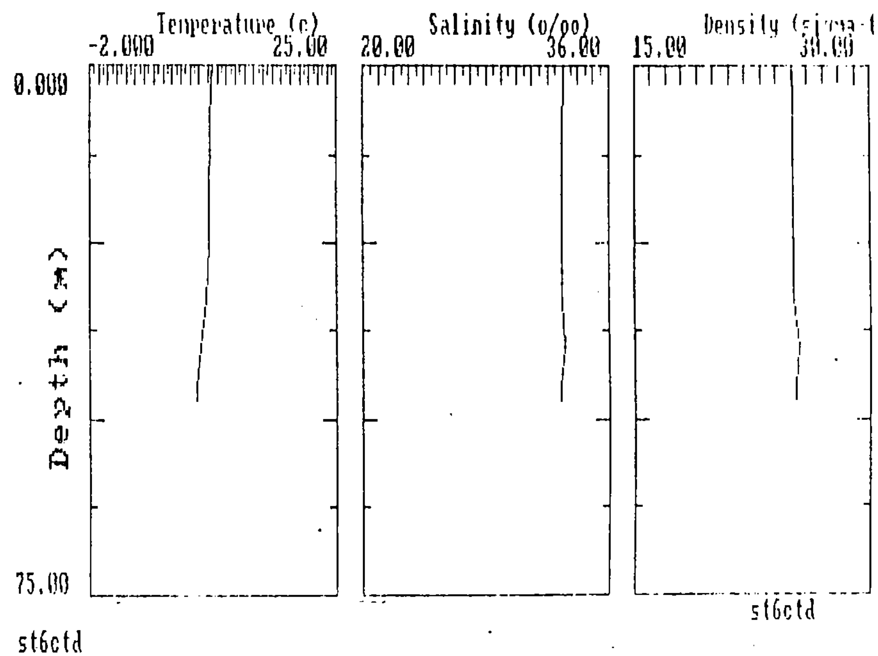
62-b	8/08	2174.3	49°10′	58°14′	125	Bay of Islands
63	8/08	2182.9	49°08′	58°02′	200	Bay of Islands, Middle Arm
64	8/08	2185.8	49°08′	57°57′	80	Bay of Islands, Goose Arm
65	8/08	2187.1	49°09′	57°55′	30	Bay of Islands, Narrows
66	8/09	2328.0	47°46′	59°41′	414	Gulf of St. Lawrence
67	8/09	2348.9	47°28′	59°43′	455	Cabot Strait
69	8/09	2358.3	47°16′	59°46′	460	Cabot Strait
71	8/10	2361.4	47°05′	59°53′	395	Cabot Strait

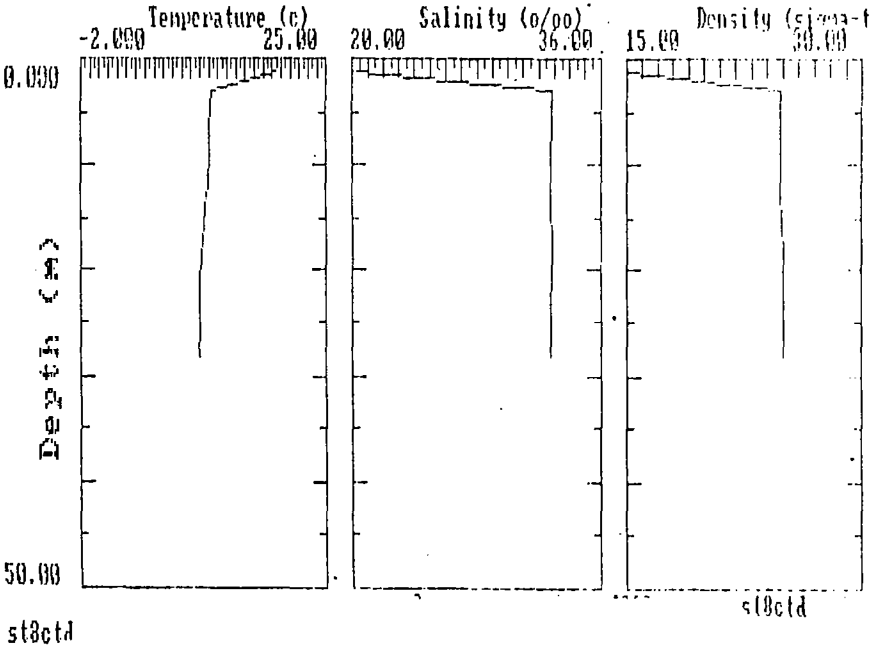
Appendix E. CTD STATION PROFILES











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Salinity (o/oo)
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36.00
Density (sigma-t
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30.00
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Depth (m)
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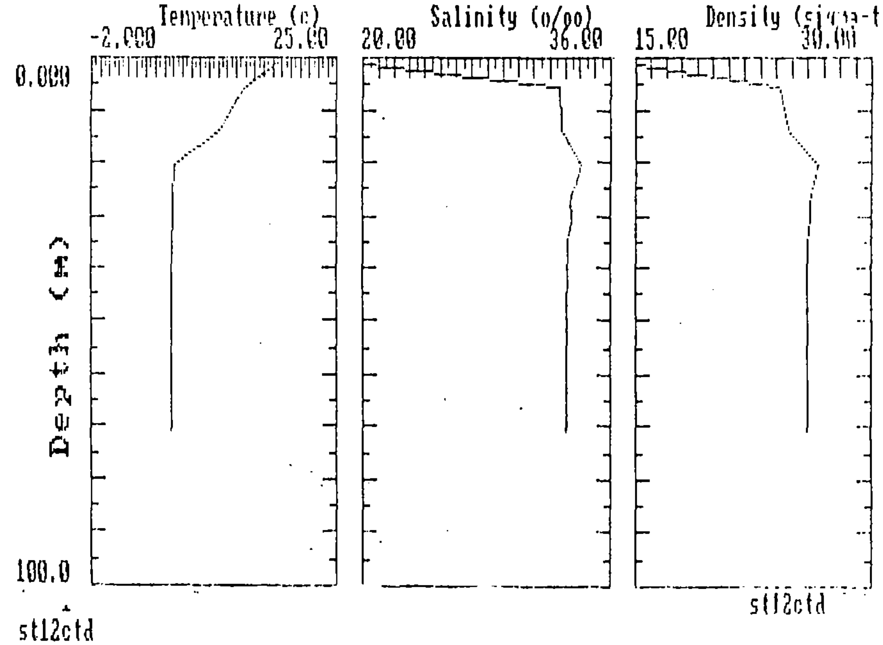

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Density (sigma-t
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Depth (m)
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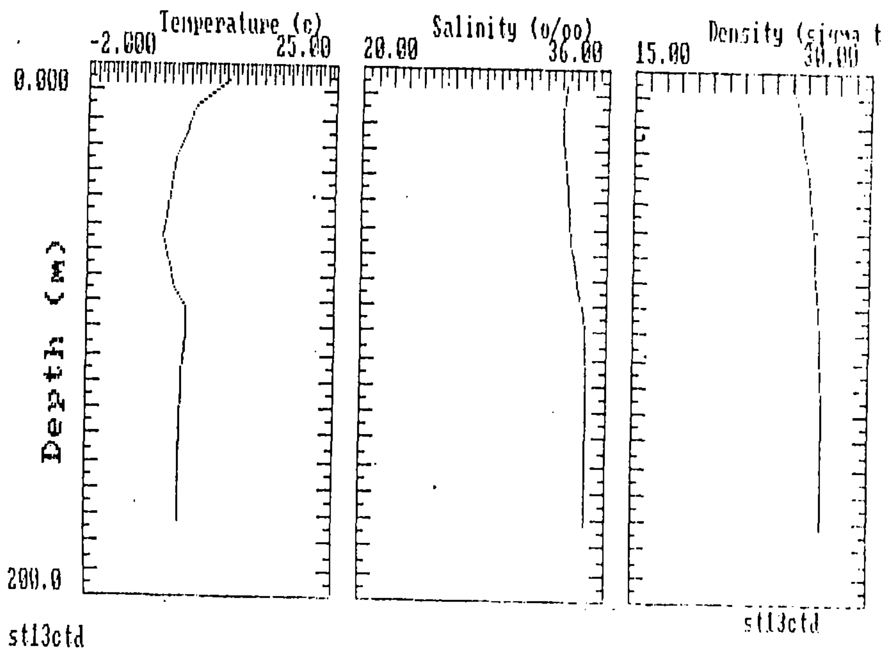

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Density (sigma t
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Depth (m)
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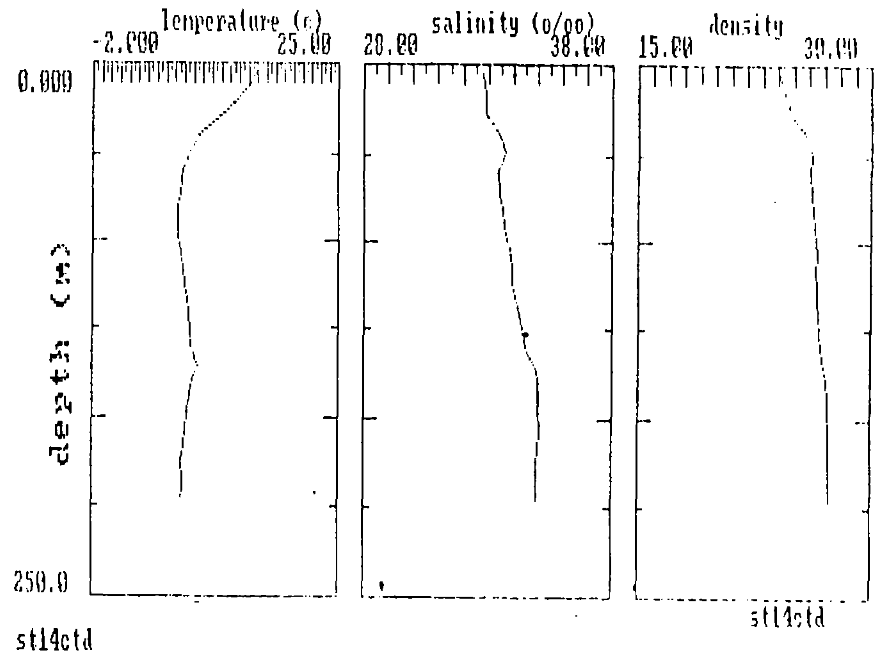

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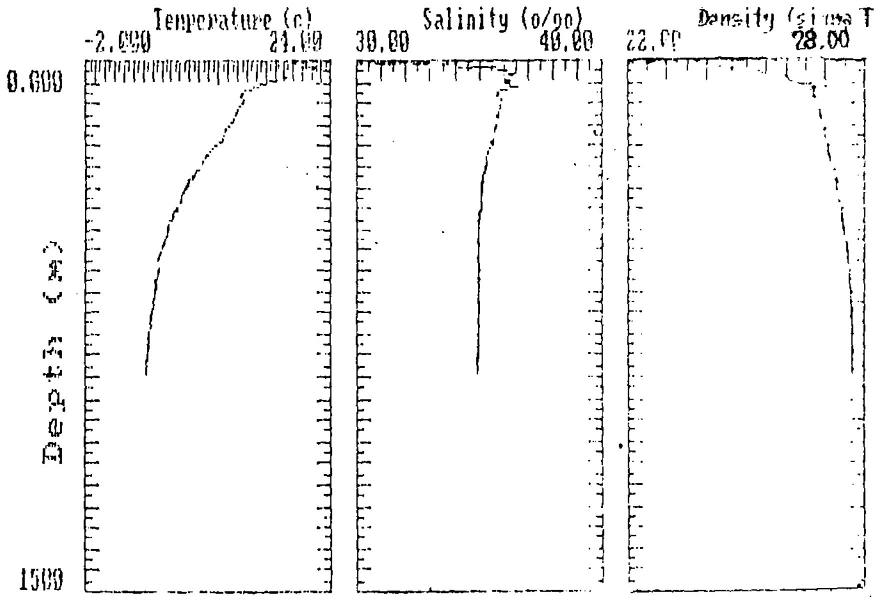

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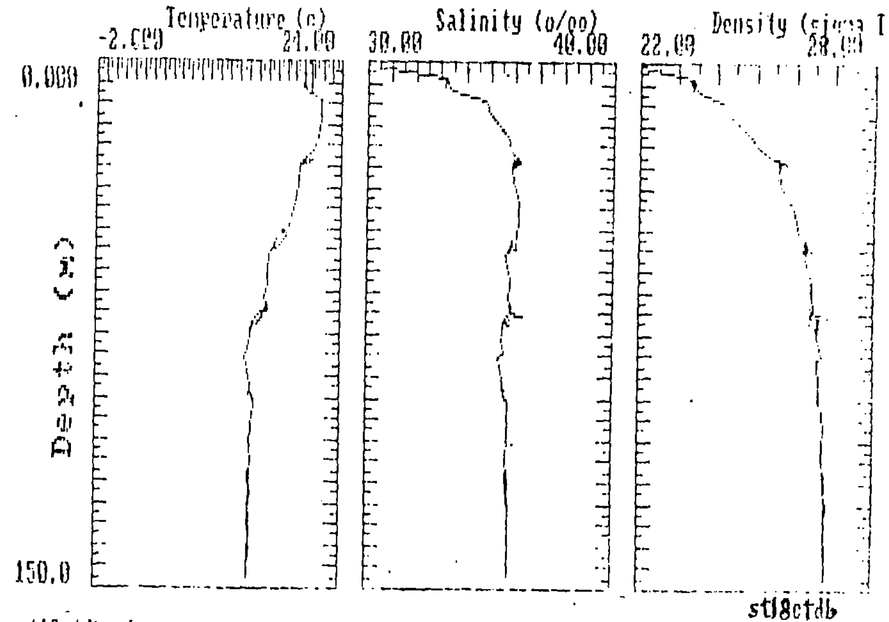

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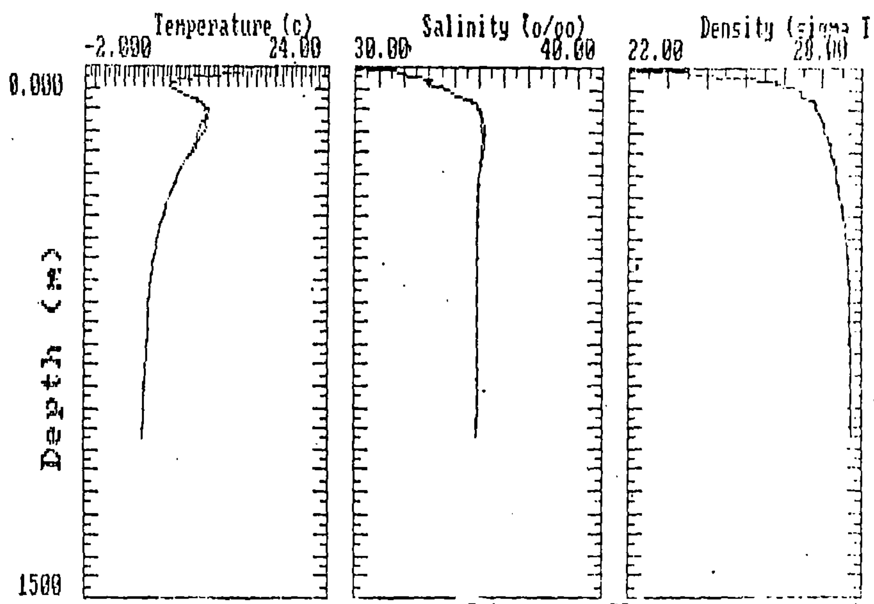

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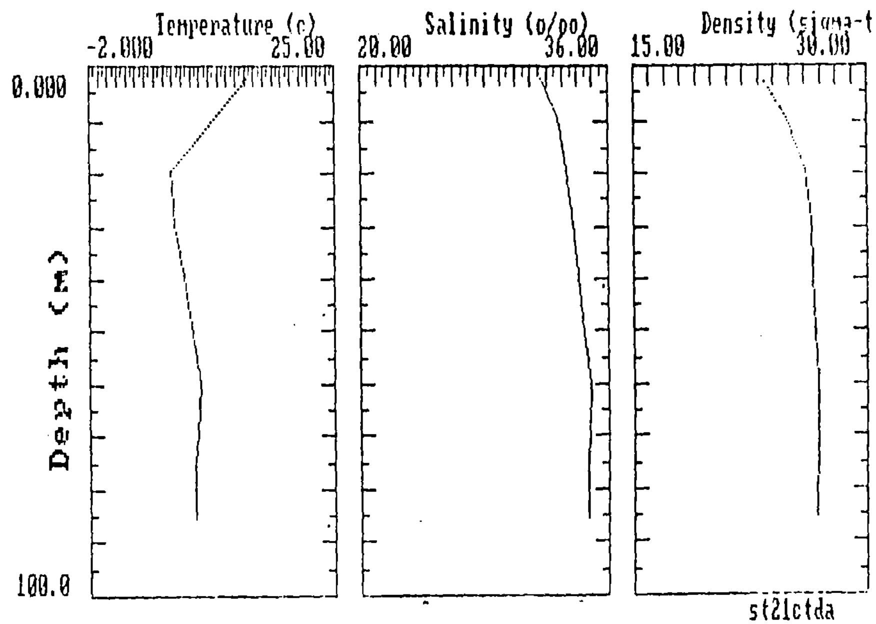

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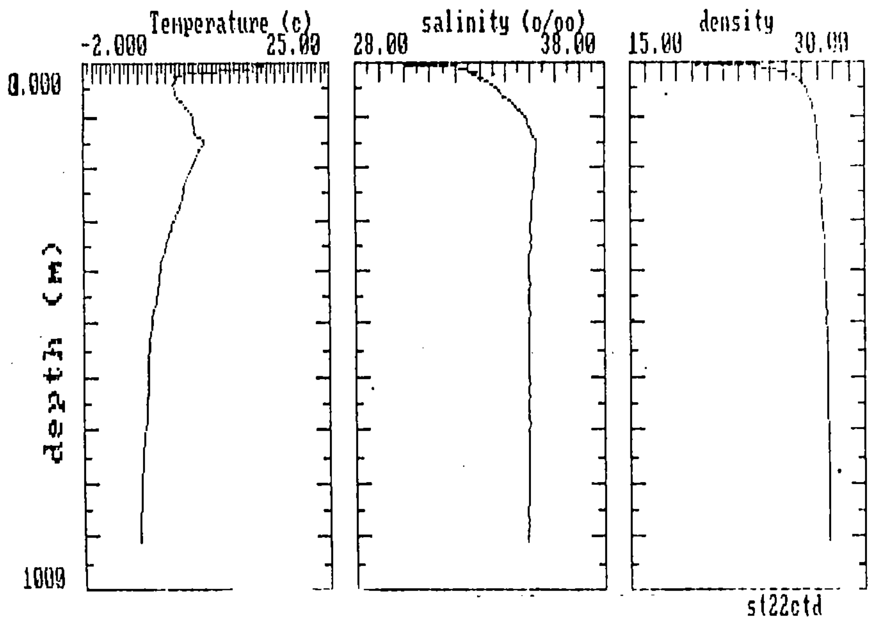

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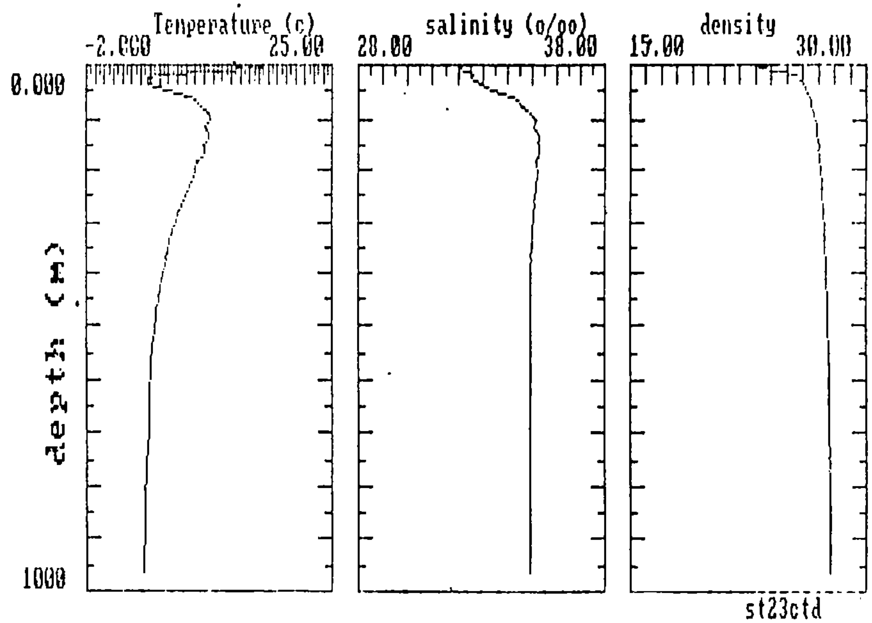

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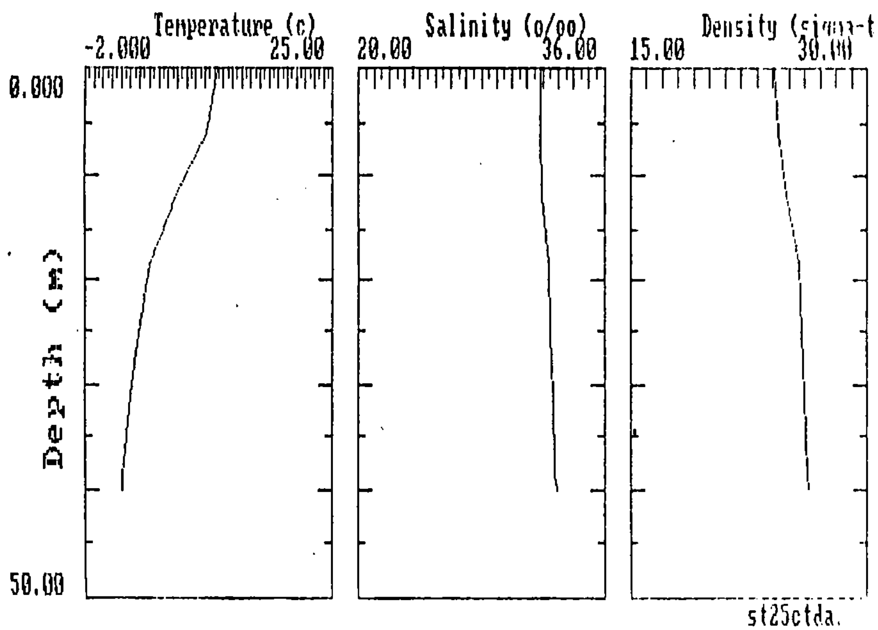

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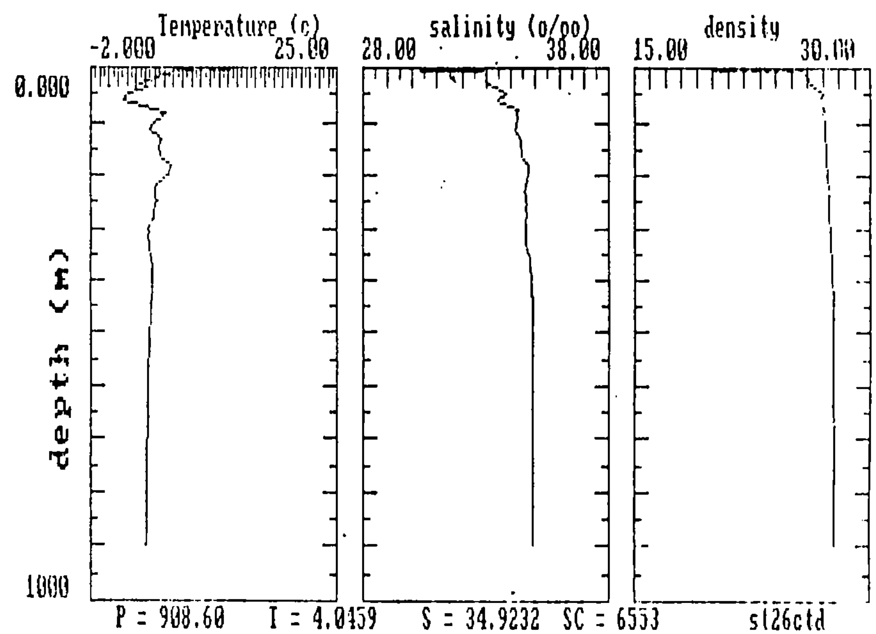

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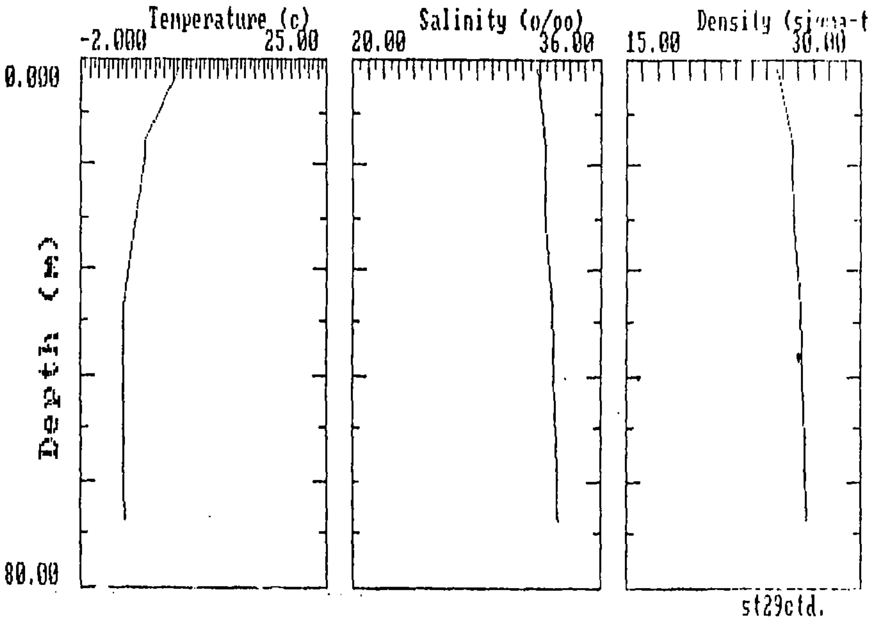
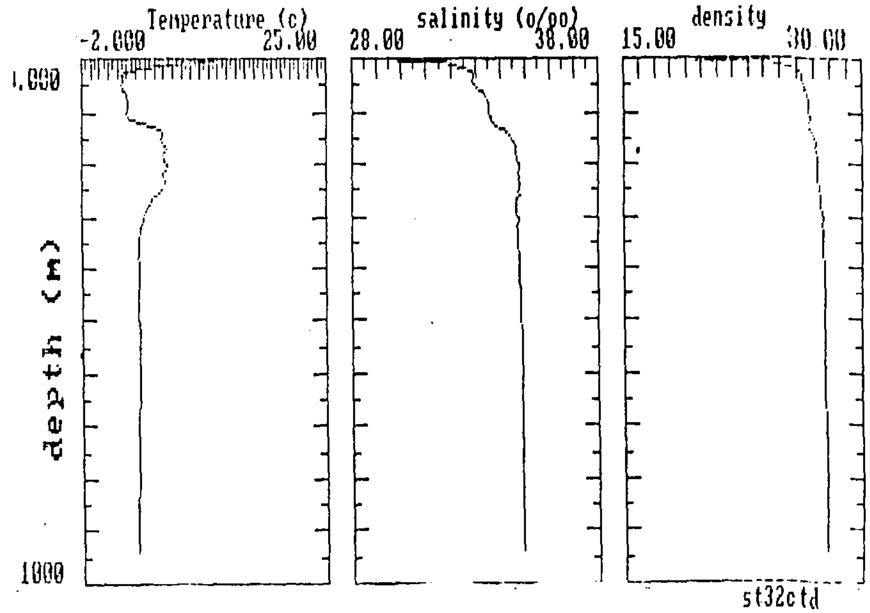
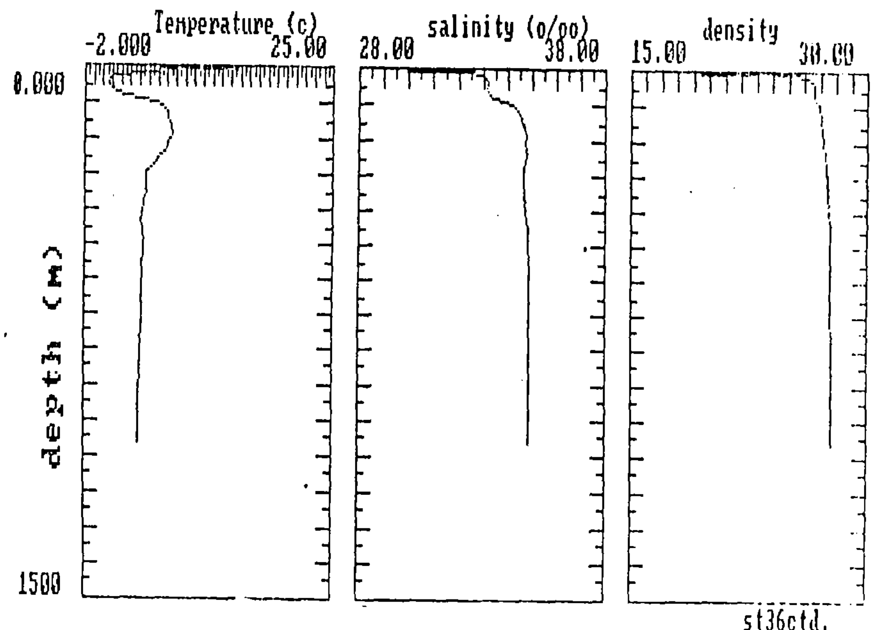




ST32CTD



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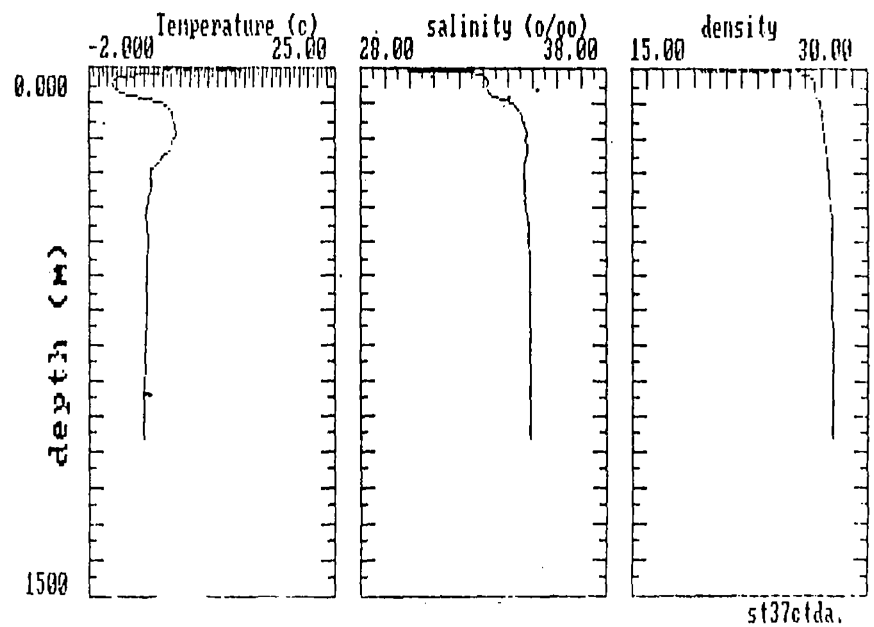

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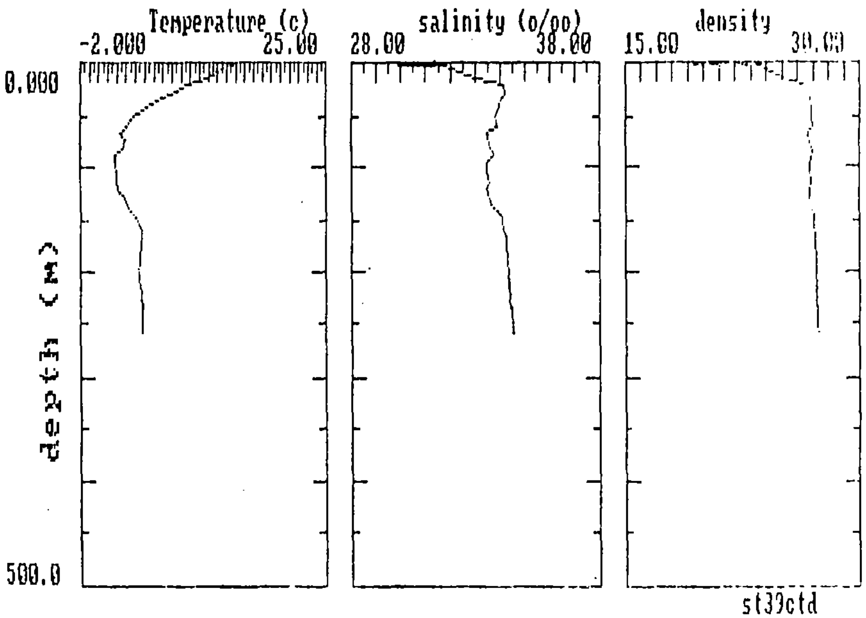

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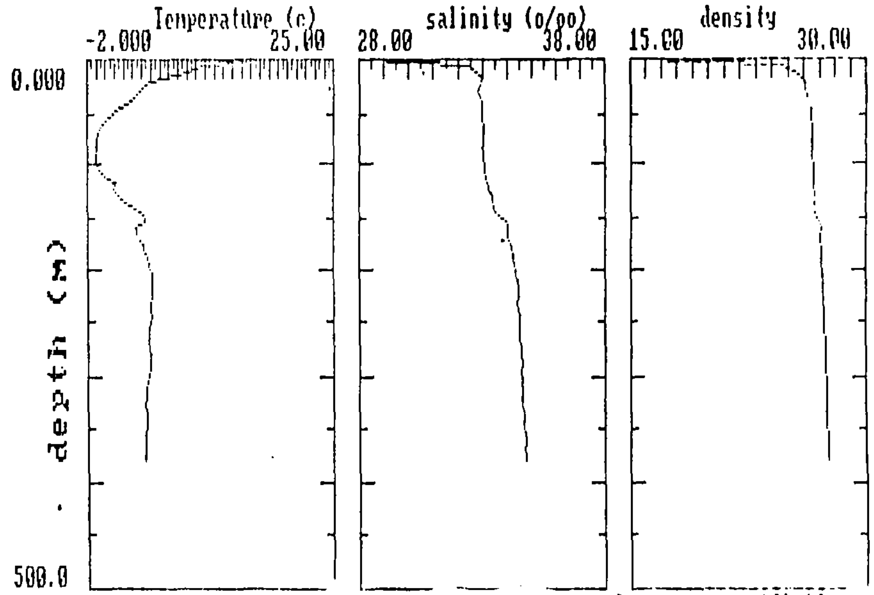

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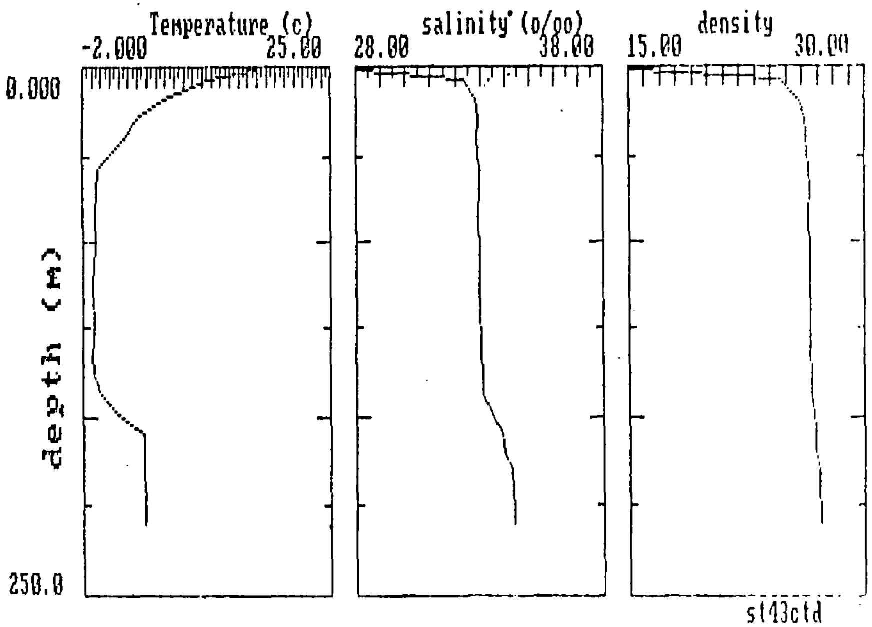
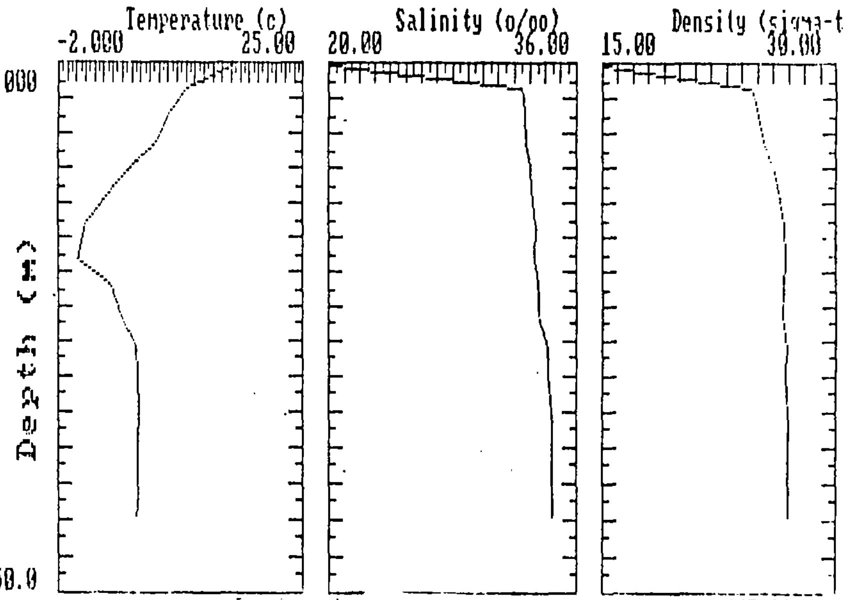


st43ctd



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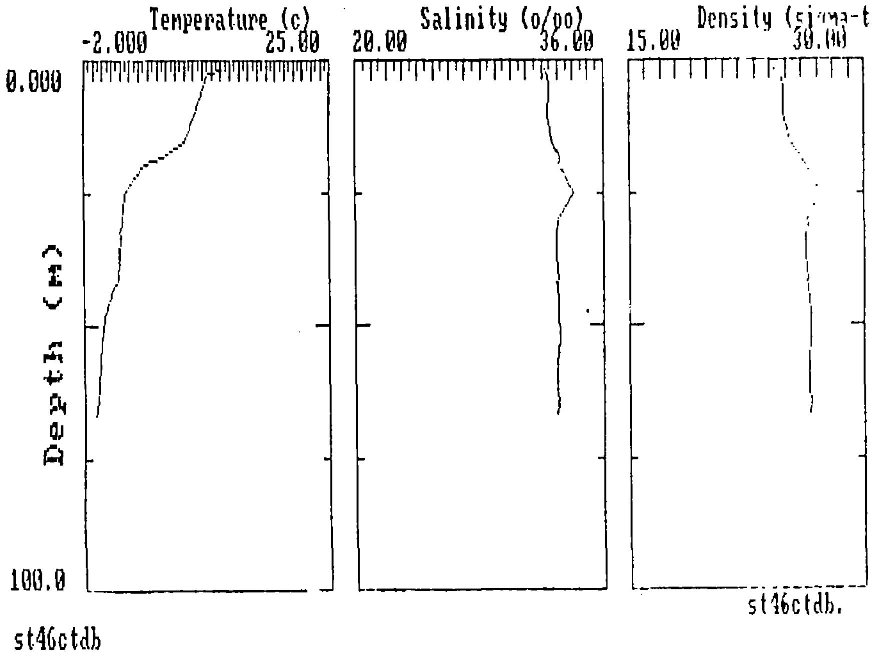
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Density (sigma-t
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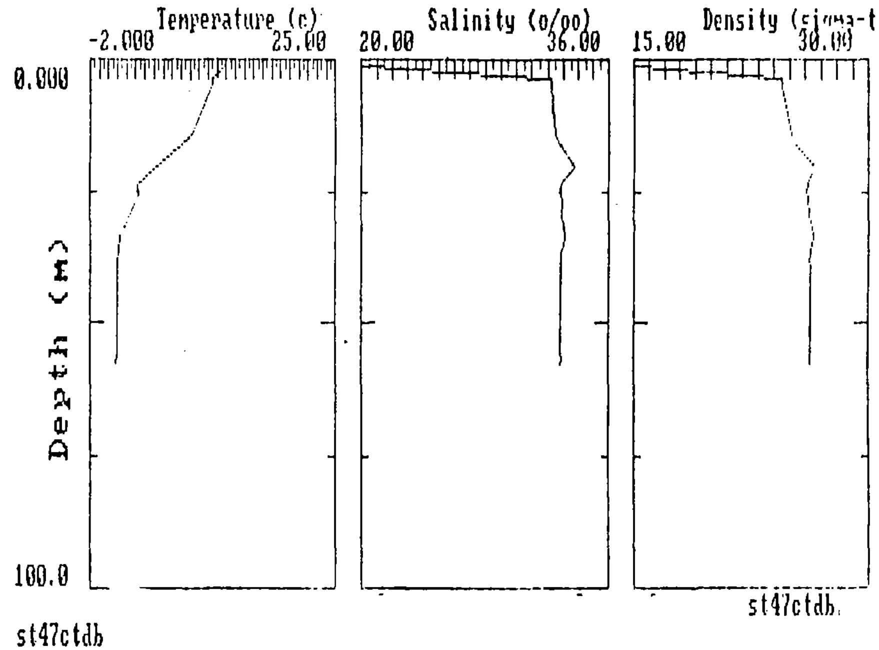
100.0
Depth (m)
st46ctdb.
st46ctdb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Depth (m)
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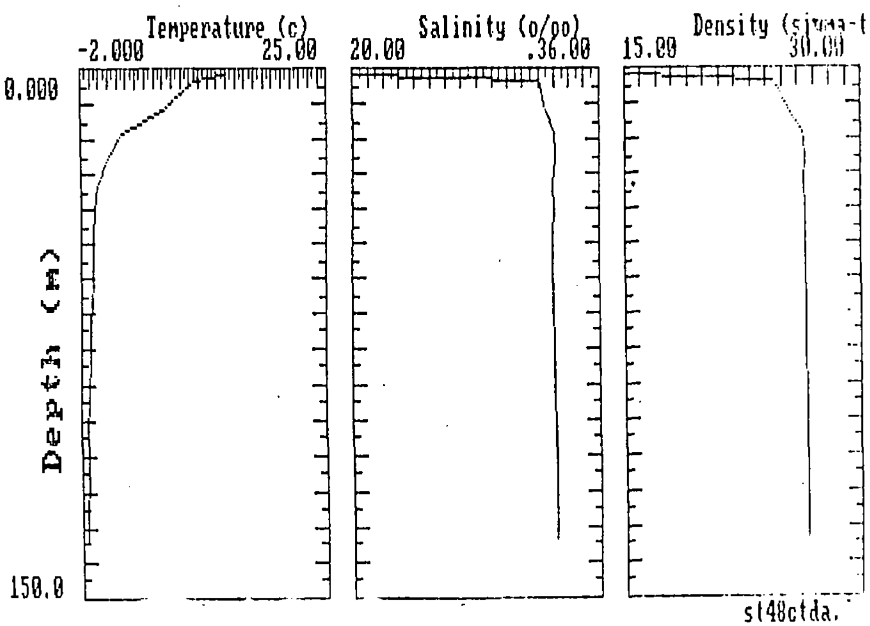
st47ctdb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Density (sigma-t
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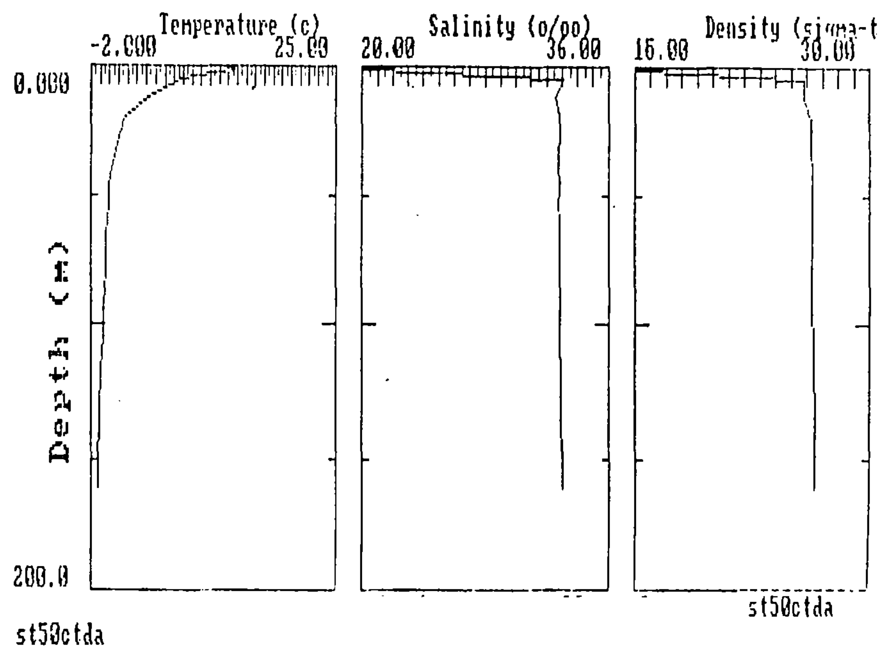
Depth (m)
st48ctda.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Salinity (o/oo)
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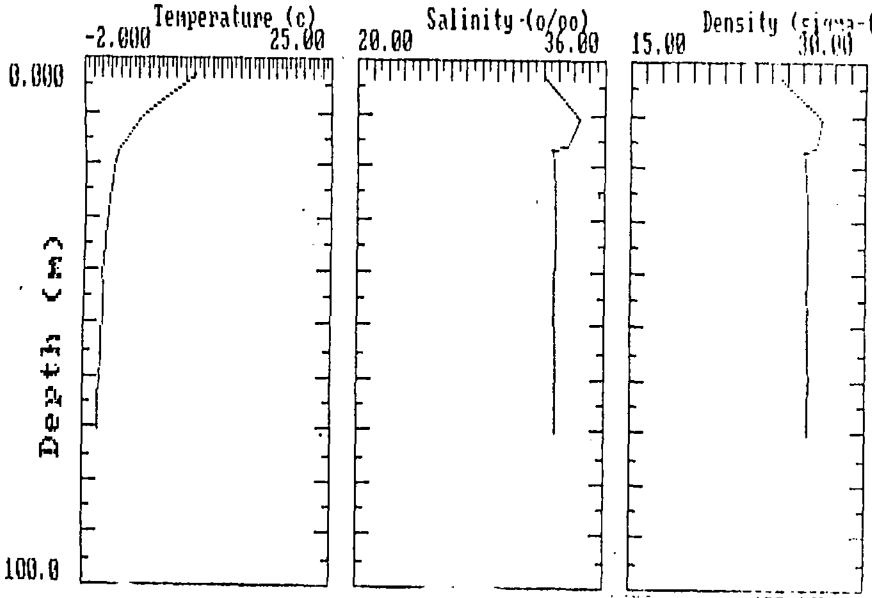
Depth (m)
st50ctda
st50ctda



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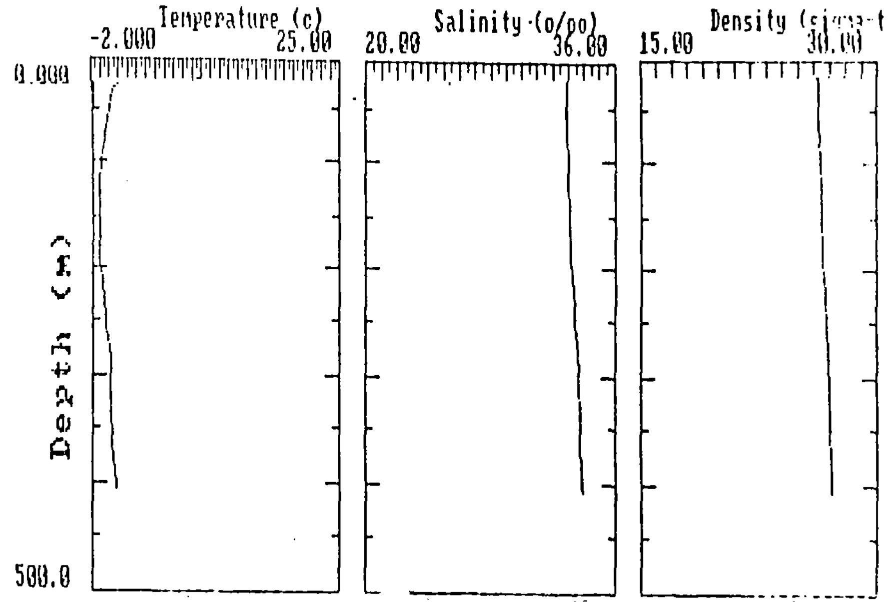

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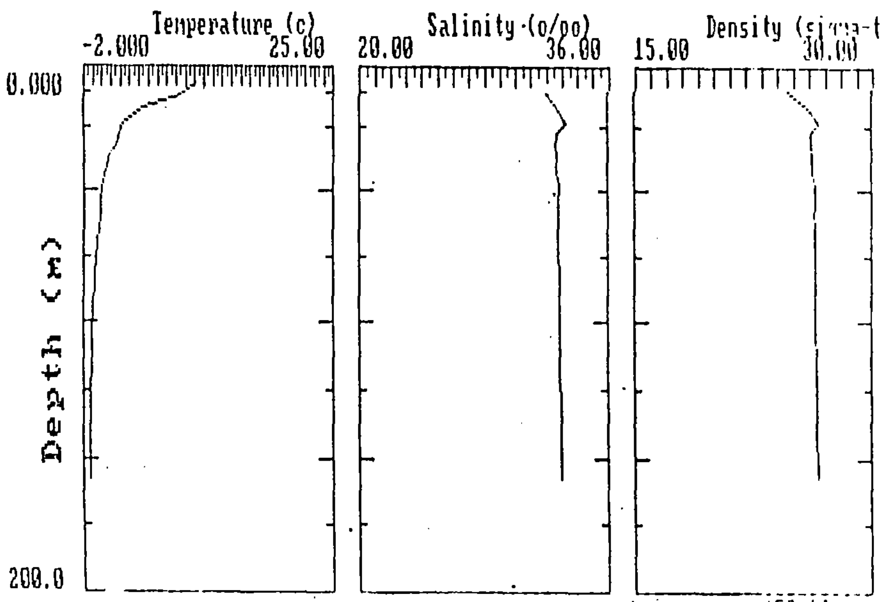

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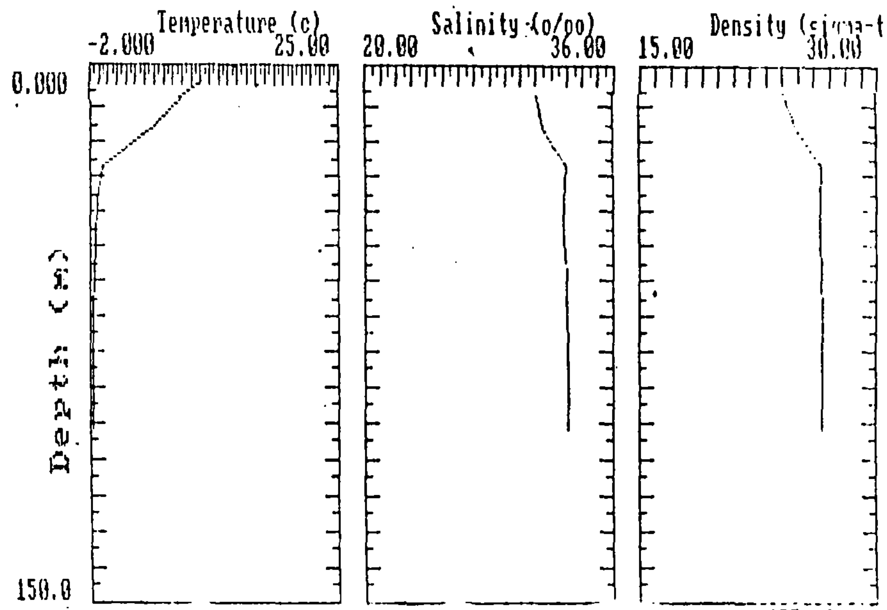

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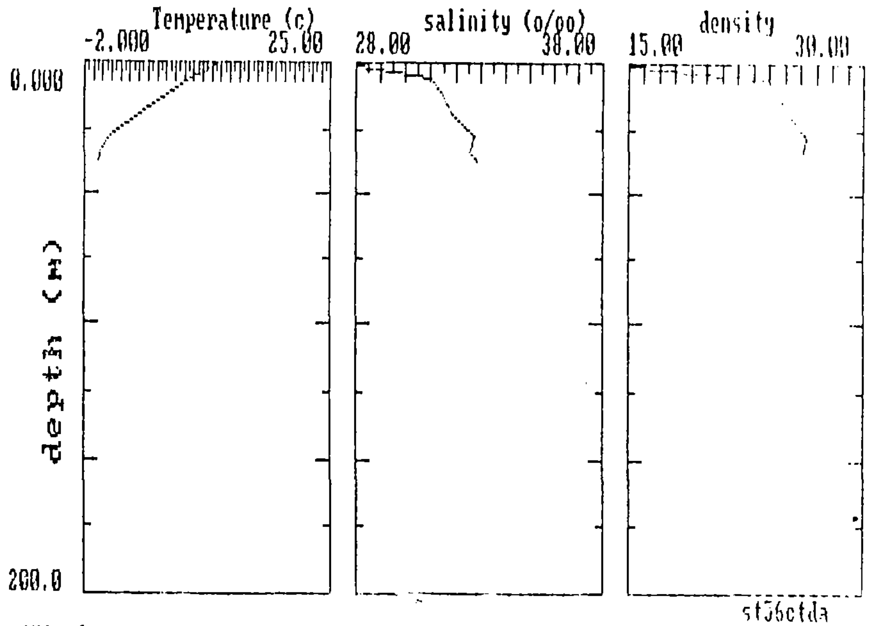

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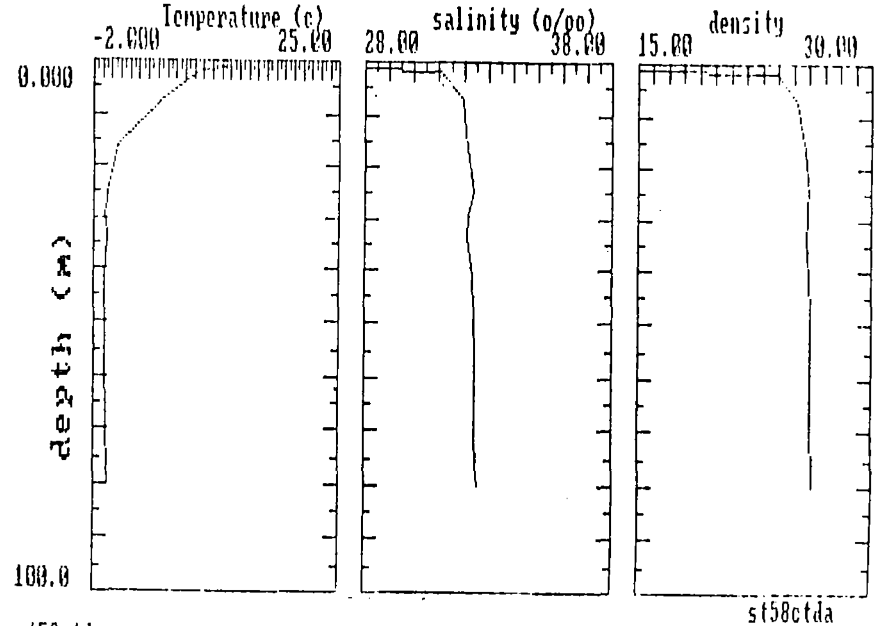

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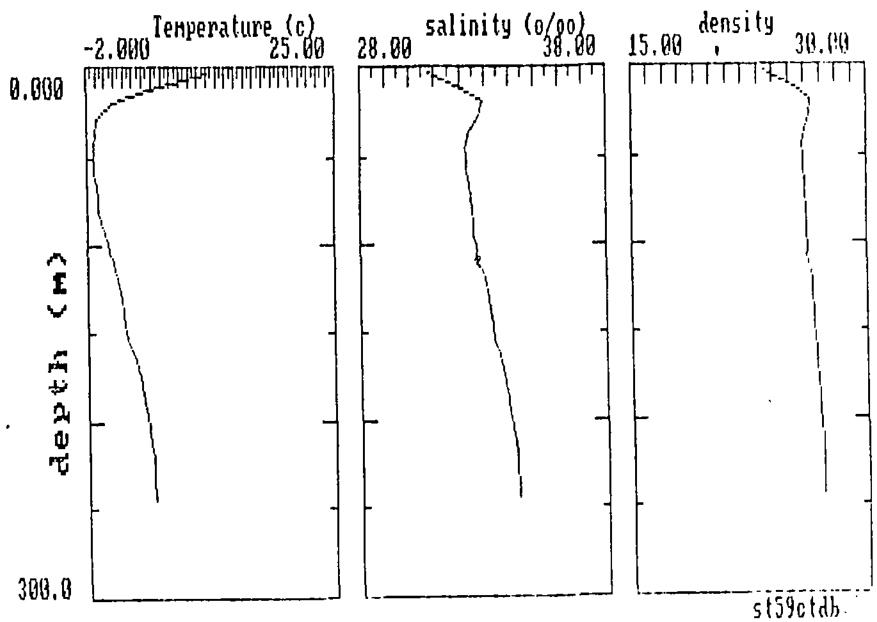

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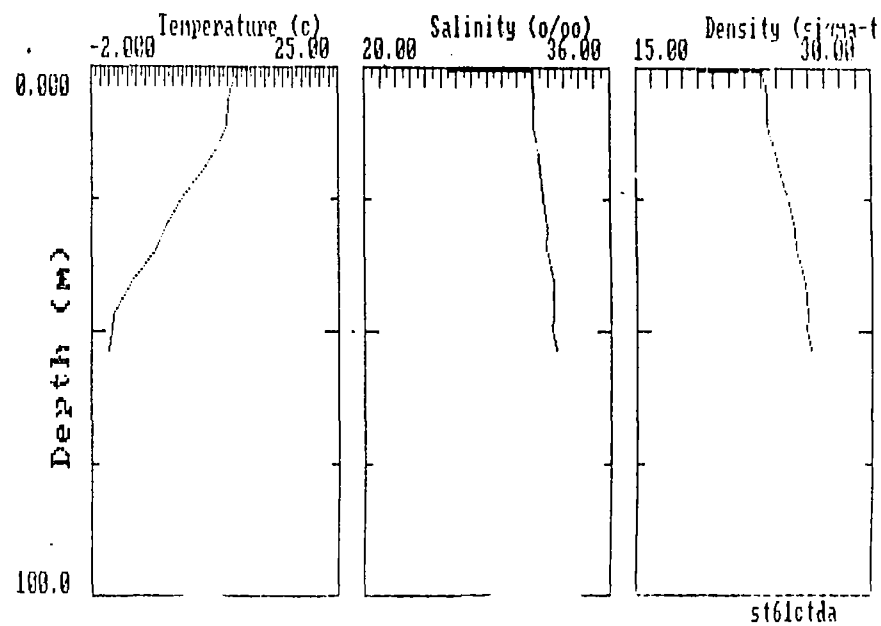

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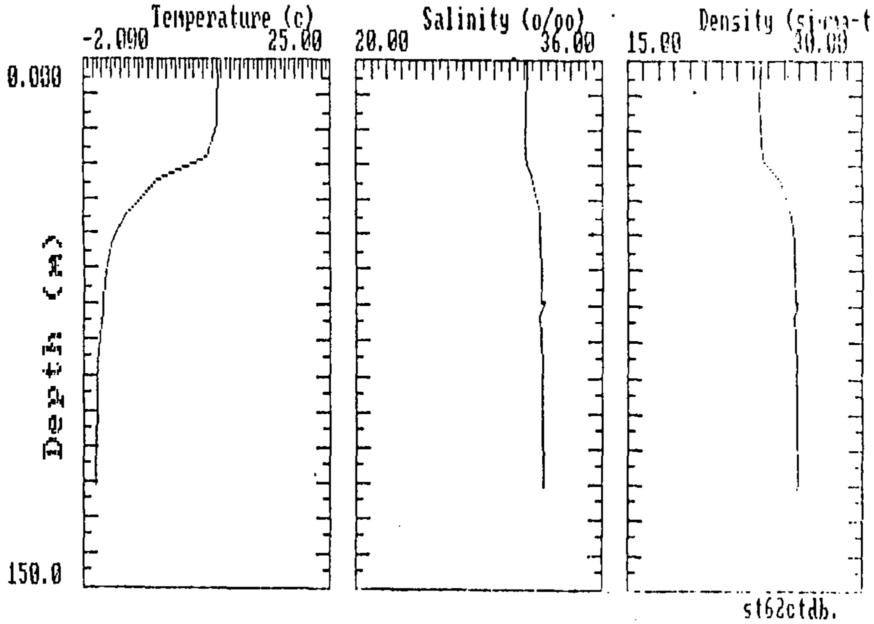
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Depth (m)
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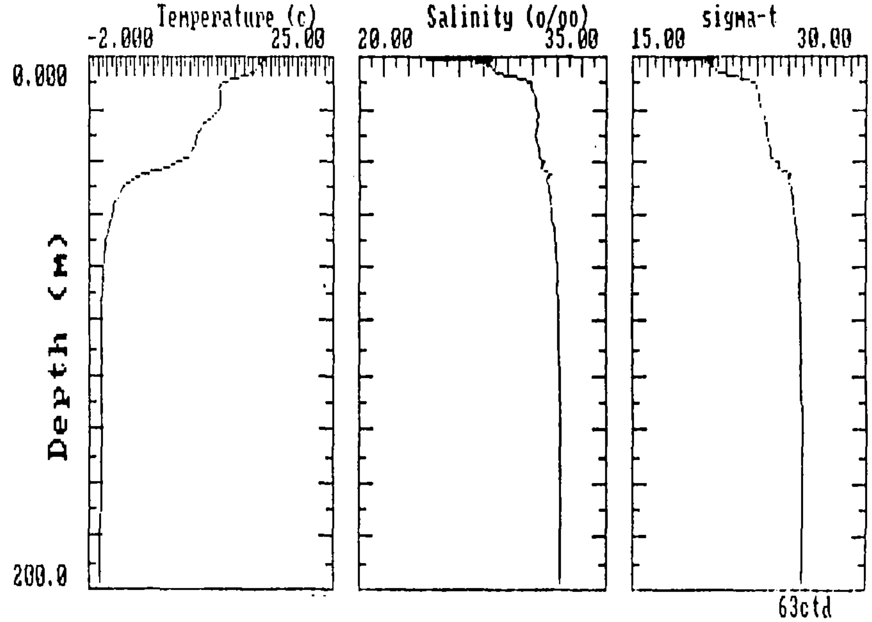
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sigma-t
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Depth (m)
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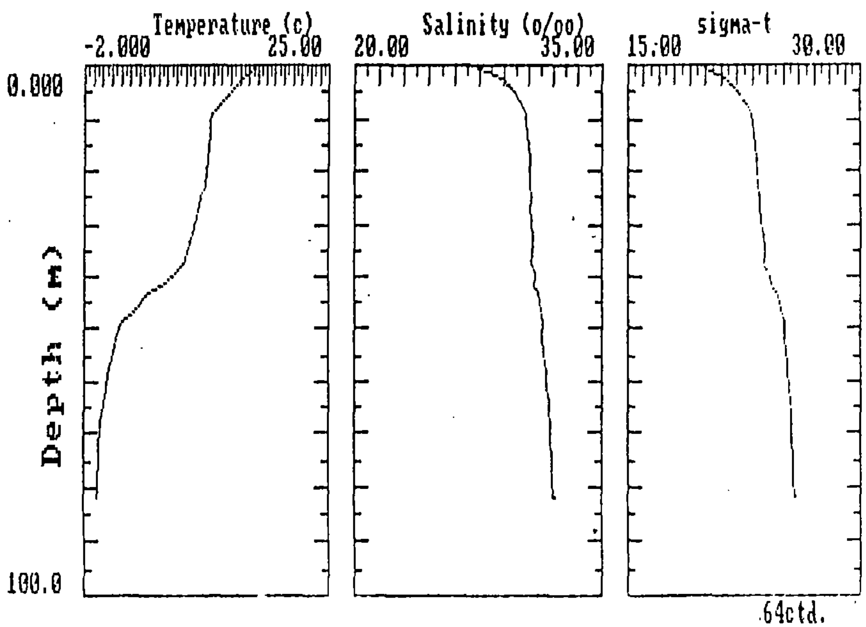
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Salinity (o/oo)
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sigma-t
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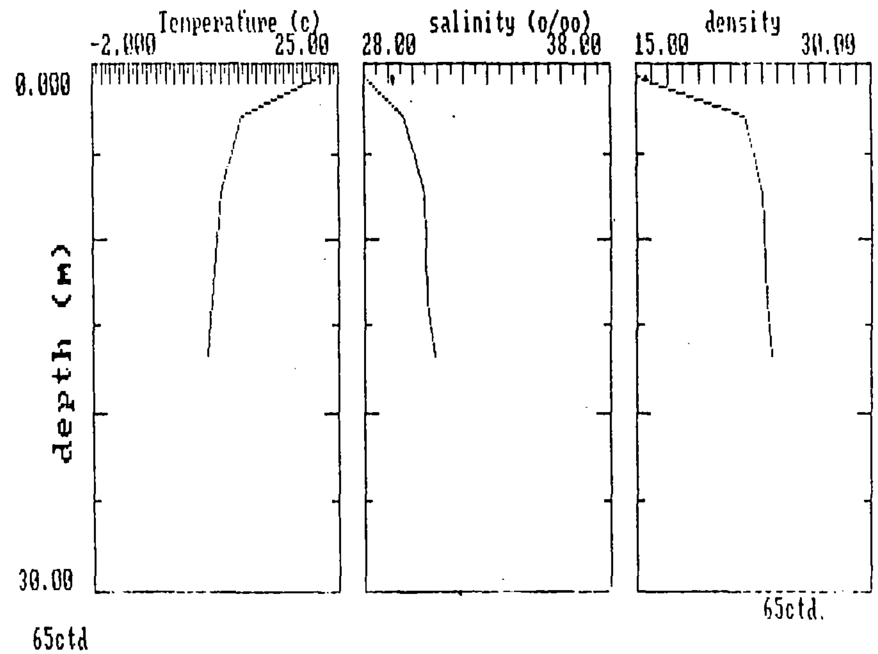
Depth (m)
64ctd.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depth (m)
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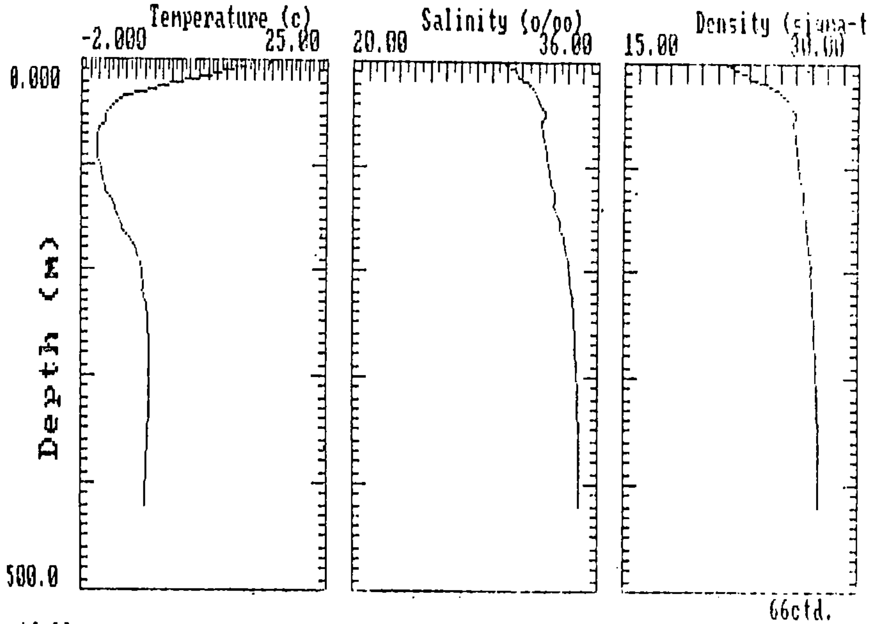
65ctd



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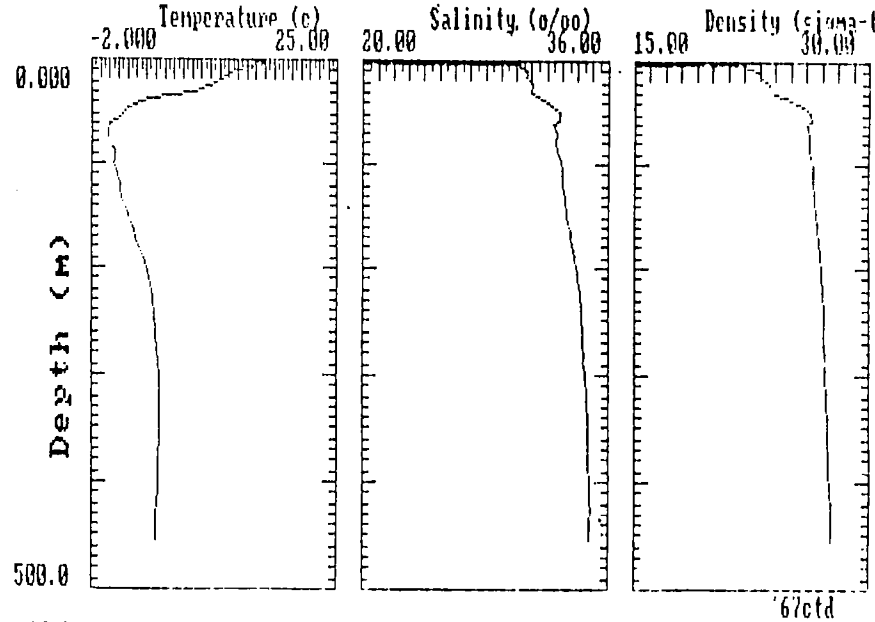
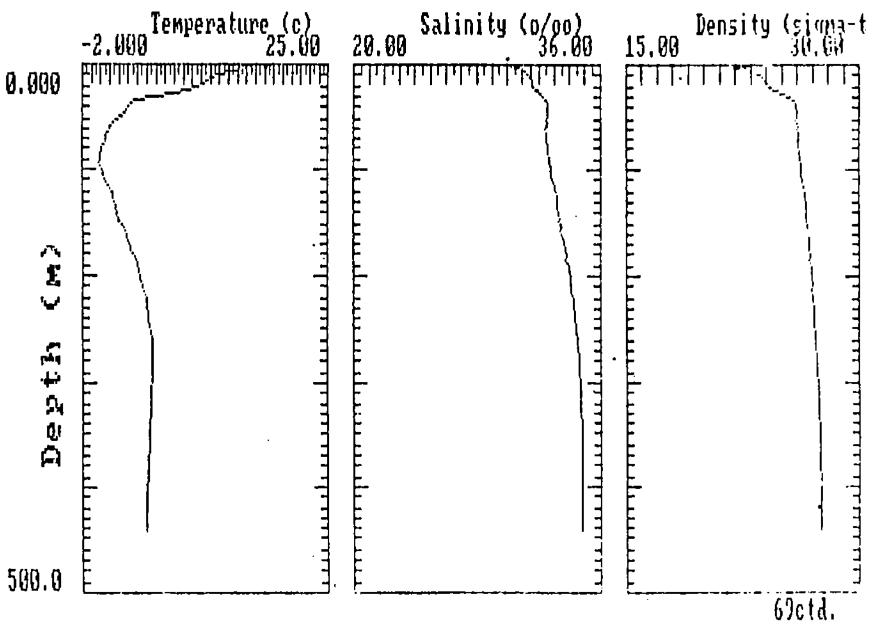
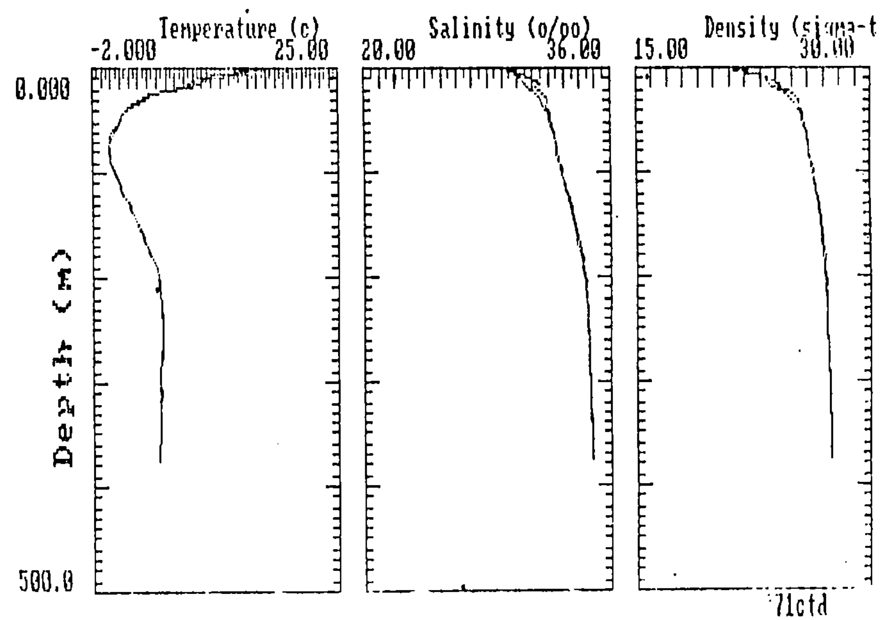


ctd 67



ctd 69



ctd 71

Appendix F. C-113 NEUSTON NET STATION INFORMATION

STATION # C-113-	DATE 1990	TIME	LOG (nm)	LATITUDE (° 'N)	LONGITUDE (° 'W)	LOCALE	TOW LENGTH (m)	ZOOP.VOL. (ml/m²)	TAR (g)	PLASTIC (pieces)
5A	7/16	1630	99.3	41 43	68 43	Great South Channel	5037	0.006	–	–
5B	7/16	1714	102.6	41 43	68 43	Great South Channel	2334	0.013	–	–
11A	7/18	0100	218.7	41 32	66 50	George Bank	3370	0.054	–	1*
11B	7/18	0144	221.2	41 33	66 51	George Bank	2593	0.032	–	
20A	7/20	1218	468.2	42 36	62 49	Scotian Shelf	1574	0.000	15*	4*
20B	7/20	1307	469.0	42 36	62 49	Scotian Shelf	2130	0.000		
38A	7/24	1207	844.1	44 13	57 45	Slope off the Gully	2685	0.004	58*	2*
38B	7/24	1245	845.8	44 13	57 45	Slope off the Gully	2778	0.006		
42A	7/25	1230	939.6	45 04	56 12	Laurentian Channel	2037	0.000	160*	27*
42B	7/25	1315	941.2	45 04	56 12	Laurentian Channel	1111	0.009		
49A	7/31	1157	1278.3	48 01	52 37	Off St. John's	1852	0.017	–	–
49B	7/31	1225	1280.0	48 01	52 37	Off St. John's	1852	0.019	–	–
54A	8/3	1840	1676.5	51 10	54 19	East of Belle Isle (60nm)	1852	0.032	–	–
54B	8/3	1940	1679.8	51 10	54 19	East of Belle Isle (60nm)	1852	0.051	–	–
57A	8/7	0005	2015.5	50 57	57 30	S. of Strt. of Belle Isle	1667	0.035	–	17*
57B	8/7	0051	2017.1	50 57	57 30	S. of Strt. of Belle Isle	2037	0.050	–	
68A	8/9	1926	2349.1	47 26	59 43	Cabot Strait	1852	0.003	18*	7*
68B	8/9	1955	2350.4	47 26	59 43	Cabot Strait	1413	0.002		
70A	8/10	0208	2360.3	47 13	59 50	Cabot Strait	1667	0.361	–	–
70B	8/10	0244	2361.4	47 13	59 50	Cabot Strait	1592	0.342	–	
72A	8/10	2031	2460.3	46 05	58 24	Laurentian Channel	1852	0.011	–	2*
72B	8/10	2100	2461.8	46 05	58 24	Laurentian Channel	1852	0.032	–	
73A	8/18	1730	3060.5	43 05	64 31	LaHave Bank	1666	0.005	–	–
73B	8/18	1803	3061.5	43 05	64 31	LaHave Bank	1296	0.008	–	–

*Tar and plastic values represent sum of net A and B collections.

Appendix G. METER NET STATION INFORMATION

Station C-113	Date 1990	Time (hrs)	Log (nm)	Position (°N)	Position (°W)	Locale	Tow Depth (m)	Flow Volume (m^3)	Zoop. Density (Ml/m^3)
10	7/17	2136	295.5	41°30′	67°00′	Georges Bank	64	407	1.400
16	7/19	0040	417.8	41°55′	63°30′	Slope Water	100	898	0.119
18	7/19	0042	293.0	42°19′	65°46′	Northeast Channel	165	919	2.740
21	7/20	2100	489.7	42°57′	62°40′	Scotian Shelf	112	689	0.261
24	7/21	2145	591.4	43°08′	61°02′	Scotian Shelf	100	726	0.220
26	7/22	2230	701.4	43°46′	58°54′	Sable Bank	100	605	0.099
27	7/23	0110	716.0	43°54′	59°07′	The Gulley	60	570	0.200
28	7/23	0237	723.0	43°57′	58°58′	The Gulley	100	1100	0.250
51	8/01	0224	1343.3	48°03′	53°19′	Trinity Bay	100	605	0.360
55	8/03	2220	1683.8	51°09′	54°31′	E. of Belle Island	100	326	0.525
60	8/07	2225	2129.8	49°37′	58°29′	N. Gulf of St. Laurence	82	393	0.623

Appendix H. OTTER TRAWL STATION INFORMATION

Sample # C-113-	Date 1990	Time	Latitude (° N)	Longitude (° W)	Depth (m)	Locale
9	7/17	1725	41°16′	67°23′	45	Georges Bank
25	7/22	1106	43°41′	60°04′	62	Sable Island Bank
71	8/11	1630	45°26′	50°46′	71	East of Cape Breton

Appendix I. MIDWATER TRAWL STATION INFORMATION

Sample # C-113-	Date 1990	Time	Latitude (° N)	Longitude (° W)	Depth (m)	Locale
44	7/25	2330	44°51′	55°28′	250	Continental Slope South of Grand Banks

Appendix J. PHYTOPLANKTON NET (63μ) STATION INFORMATION

STATION # C-113-	DATE 1990	LOG (nm)	LATITUDE (° 'N)	LONGITUDE (° 'W)	DEPTH (m)	LOCALE
1	7/16	47.3	42 04	69 45	200	Great South Channel
2	7/16	63.7	41 56	69 27	216	Great South Channel
3	7/16	79.6	41 48	69 06	179	Great South Channel
4	7/16	97.3	41 39	68 43	57	Great South Channel
5	7/17	130.2	41 23	68 23	67	Georges Bank
6	7/17	142.1	41 15	68 12	47	Georges Bank
8	7/17	183.1	41 10	67 28	54	Georges Bank
12	7/18	256.7	41 56	66 04	99	Georges Bank
13	7/18	277.9	42 05	65 59	200	Northeast Channel
14	7/18	279.5	42 08	65 55	228	Northeast Channel
15	7/18	288.6	42 15	65 51	225	Northeast Channel
16	7/18	293.0	42 19	65 46	131	Northeast Channel
17	7/19	328.1	42 37	65 18	96	Off Browns Bank
25	7/22	638.6	43 39	60 09	67	Sable Island Bank
29	7/23	730.1	43 56	59 04	140	The Gully
30	7/23	730.4	43 55	59 03	260	The Gully
31	7/23	732.5	43 55	59 02	540	The Gully
33	7/23	738.9	43 55	58 56	562	The Gully
34	7/23	741.3	43 55	58 56	427	The Gully
35	7/23	744.7	43 59	58 54	200	The Gully

Appendix K. SHIPEK GRAB STATION INFORMATION

STATION # C-113-	DATE 1990	TIME	LATITUDE (° ′N)	LONGITUDE (° ′W)	LOCALE
8	7/17	1337	41 10	67 28	Georges Bank
12	7/18	0955	44 56	66 04	Georges Bank
18	7/19	2330	41 55	63 30	Warm Eddy
21	7/20	1845	42 57	62 40	Scotian Shelf
23	7/21	0710	42 28	61 47	Continental Slope
25	7/22	0925	43 39	60 09	Sable Island Bank
48	7/27	0115	46 16	52 48	Grand Banks
53	8/3	0810	51 05	53 16	Funk Island Bank
56	8/4	0600	51 34	54 59	East of Belle Isle
58	8/7	0845	50 43	58 08	Gulf of St Laurence
59	8/7	1300	50 21	58 21	Gulf of St Laurence
61	8/8	0450	49 14	58 35	Outside Bay of Islands
62	8/8	1100	49 10	58 14	Bay of Islands
63	8/8	1310	49 08	58 03	Bay of Islands,Middle Arm
64	8/8	1520	49 08	57 57	Bay of Islands,Goose Arm
65	8/8	1642	49 09	57 55	Bay of Islands,Narrows